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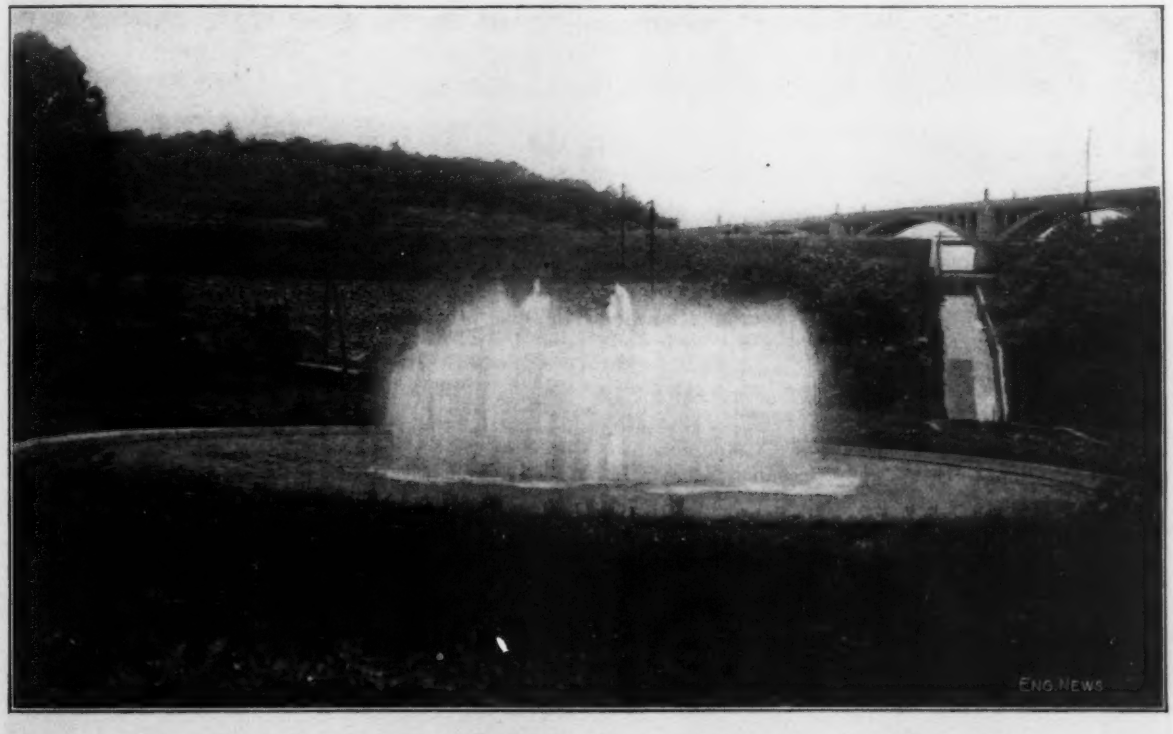
The Influence of Reservoir Bottoms on Stored Water

By Wilson Fitch Smith*

The nature of artificial reservoir bottoms has a direct influence upon the quality of the stored water. The character of the soil and vegetation of the bottom and adjacent sides of the reservoir, the depth and the proportion of shallow-flowage areas, all have important influences upon the tastes and odors of stored waters. The objectionable tastes and odors are produced either by the putrefaction of the organic matter on the bottom as the result of stagnation in deep basins or by the decay of organisms, such as algæ, which grow near the surface of the water. The oxidation of organic matter provides the growing organisms with food, and when present in quantity, is an active means of encouraging their growth. Therefore, it would appear that if the organic matter present in vegetation and soil is removed by clearing and stripping the soil, the source of bad tastes and odors would be removed.

At one time it was felt by many engineers and chemists that the best results could be obtained only by a complete stripping of the surface soil to such a depth that the remaining exposed surfaces should have less than a certain arbitrary percentage of organic matter, and considerable sums of money have been expended in removing the surface soils from certain reservoirs, with unquestionably good results. Experience has shown, however, that these results are not a permanent prevention of tastes and odors, as there are other sources of organic matter. The entering water brings with it in suspension organic matter from the surrounding drainage areas, and this, with the remains of the dying surface growths, is continually precipitated to form increasing accumulations on the bottom, which in time will result in a bottom condition that will be the same whether the bottom was stripped or not.



Aerator on Pipe Line from Temporary Reservoir above the New Kensico Dam
(Temporary dike in background.)

Studies of Kensico, Williamsbridge, Jerome Park and Central Park Reservoir Bottoms

That the accumulations on the bottoms of reservoirs may contain more organic matter than the original soil was demonstrated by some investigations made by the Board of Water Supply at the time the question of treatment of the bottoms of the Ashokan and Kensico reservoirs of the Catskill Water Supply System for New York City was under consideration.

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FIG. 1. CHARACTER OF SWAMP GROWTH

FIG. 2. AFTER REMOVING GROWTH

SWAMPY BOTTOM OF PORTION OF KENSICO RESERVOIR

Samples were procured from the bottom of the old Kensico Reservoir, built in 1883. This reservoir covered 255 acres to a maximum depth of 45 ft. The area was a rolling open valley of glacial origin with a light soil under farm cultivation. Except for the clearing and burning of the vegetation, no special treatment of the bottom was made. The soil of the adjacent sides contains from 4.7% to 9.9% of organic matter. Samples of the bottom secured at 18 stations in various parts of the reservoir after 24 years' service showed an average of 8.5% organic matter in the original soil, and 12.7% organic matter in the overlying deposit of silt. The depth of the latter varied up to 18 in. and averaged more than 6 in. These results clearly show that in this reservoir the stored water has produced and introduced organic matter which in a comparatively few years has accumulated to an extent to surpass the organic condition of the original bottom soil, and that the beneficial results of stripping would have been only temporary.

To further demonstrate the character of reservoir silt, samples were taken from several of the storage reservoirs of the city which receive water only through aqueducts or pipes from the impounding reservoirs. Twelve samples of the bottom silt from the Croton reservoirs in Central Park averaged 16.5% organic matter, while four samples from the Williamsbridge Reservoir, receiving water

FIG. 3. COVERING SWAMPY AREA OF KENSICO RESERVOIR

FIG. 4. SWAMPY AREA OF KENSICO RESERVOIR AFTER HAVING BEEN COVERED WITH DIRT

from the old Kensico Reservoir, averaged 19% organic matter, and eight samples from the Jerome Park Reservoir, after only 13 months of service storing Croton water, averaged 23.3% organic matter. One of the Central Park reservoirs and the Williamsbridge and Jerome Park reservoirs have concrete floors, the depth of water being 20 ft., 37 ft. and 23 ft., respectively. In these, the depth of silt indicates an accretion of from ⅛ to ¼ in. per year. The microscopic examination of the residue of the samples from these storage reservoirs showed it to consist largely of algæ and diatoms with very little vegetable débris.

In general practice, filtration has for a long time been employed as a means of removing tastes and odors from stored waters and is more or less efficient, depending upon the type of filter used, adequate design and management. More recently, aëration has been employed for this purpose, and with increasing success. The most efficient aëration is that which divides the water into a fine spray under such a head that the individual drops are exposed

WITH DIRT FROM BORROW PITS AFTER REMOVING GROWTH

to the air for several seconds, resulting in an oxidation of the organic matter in the water, thus removing the cause of taste and odors. The simplicity and small cost of this method are strong arguments in its favor.

The above general remarks apply only to upland soils. Where swamps, bogs or river bottoms, containing deep deposits of alluvial mud form a considerable part of the reservoir bottom, special treatment of some kind will probably be desirable. The following notes describe a simple treatment which gave very satisfactory results and made possible the immediate use of stored water on a swamp area.

Treatment of Swampy Area of Reservoir Bottom

The new Kensico Reservoir, a part of the Catskill water-supply system for the City of New York, which is now nearing completion, is located in the Valley of the Bronx River a few miles north of White Plains, in Westchester County. It is formed by a large masonry dam, described in Engineering News, of Apr. 9 and May 21, 1914, and will cover 2218 acres of land, submerging the old Kensico Reservoir 110 ft. The old reservoir was built in 1883 by the Department of Water Supply and developed the local drainage of the upper reaches of the Bronx River and its tributaries, including the Rye Ponds, and by a diverting weir and tunnel that portion of the Byram River drainage in New York State.

The most favorable location for the new Kensico Dam was found to be about 400 ft. above the old dam. In order to make this site available, it was necessary to provide a temporary substitute supply. This was done by building two rolled embankment dikes farther up the valley, each about 40 ft. high, one across the Bronx River and the other across the Rye outlet and extending the Bronx pipe line by a 36-in. riveted steel pipe to the Rye dike. The two basins thus formed were connected by a short tunnel and have an available capacity of 5064 million gallons, which is 1800 million gallons larger than the old Kensico Reservoir and more than compensates for the reduced catchment area, which is three miles less than the old reservoir.

This temporary reservoir covers 708 acres, 200 acres of which was swamp land about 28 ft. below the surface of the full reservoir. A large portion of these swamps was of considerable depth. Samples from a depth of 30 ft. showed more than 75% of organic matter. These areas were covered by a rank growth of tussocks and other swamp vegetation. It was feared that these swamps would impart both tastes and odors to the water to an objectionable extent, and as it was essential to use the water as soon as it could be stored, the special treatment of these swamps was considered.

On account of their depth, it was practically out of the question to strip the swamps completely, and to remove only the surface growth would lay bare the underlying muck, which would probably prove more objectionable than the surface growth. It was finally decided that satisfactory results would be obtained if the swamps were cleared and covered with a thin layer of soil, which would act as a blanket to prevent the decomposed organic matter from mingling with the water. Favorable borrow pits were located on the margin of each swamp. The material ranged from a modified glacial drift of fine sand to a more compact soil of finer grain. Steam shovels and an equipment of narrow-gage 18-ton locomotives and 4-cu.yd. side-dump cars were installed by the contractor. The swamps were first cleared by cutting off the surface growth, including tussocks, down to the general swamp level. The tussocks offered considerable resistance, but yielded to sharp grub hoes. The disposal of the tussocks was at first a problem, but it was found that after drying in piles for several months they would readily burn. Fig. 1 shows the character of swamp and swamp growth. Fig. 2 shows a swamp after clearing.

The covering was run out onto the swamp in 10-car trains running on tracks of 60-lb. rails carried on 8-ft. ties laid on the cover. After dumping, it was spread to about 12 in. depth, over the shallower and dryer swamps, while on the deeper swamps it was necessary to increase the depth of cover to about 18 in. This would usually support the load satisfactorily, and it was surprising to see how elastic it was. As the trains passed over it the surface would deflect several inches, forming a wave under the traffic, but as long as the covering did not become saturated by absorbing the swamp water by capillarity, it would satisfactorily sustain the load. A large part of the cover was spread by hand, but later the contractor provided car scrapers which were operated by locomotives. Fig. 3 is a general view of the covering operation. Fig. 4 shows a swamp after the covering was spread.

Aerator on Reservoir Outlet

An aërator of capacity sufficient to pass the whole supply was built on the pipe line (see front-page view). This consists of a circular concrete basin 100 ft. in diameter with a 24-in. delivery pipe laid in a circle of 20-ft. diameter, carrying 44 nozzles. The nozzles are of special design, having interior spiral flanges which impart a decided spiral motion to the jet, causing it to completely break into spray a short distance above the nozzle. This aërator absorbs about 20 ft. effective head.

Frog Guard Rails of Special Design

The guard rails placed opposite frogs in railway track, to hold wheels in position while passing the frog point, are usually pieces of ordinary rail, suitably fastened to the ties and to the running rails. Guard rails consisting of heavy steel angles have been use to a limited extent, and we describe below three other special designs.

Morrison Guard Rail

This is a rolled steel rail of distorted T-section, as shown in Fig. 1. It has a narrow flange on the inner side, and a head of unsymmetrical section, while the web is inclined toward the track rail so as to better resist any thrust coming against it from the back of the wheel. A special tie-plate is used, holding both rails. This has a lug to hold the inner flange of the guard rail and prevent it from tilting under pressure, and has also shoulders to engage the outer flange of track rail and so prevent them from being displaced laterally.

The guard rail has spikes only on the outside, while the track rail has spikes on both sides. There are three holes for the outer spikes, in staggered position, as shown, so that the rail can be shifted inward to maintain the proper width of flangeway when the head is worn. The guard rail and tie-plates are in use on several railways

and are manufactured by the Cambria Steel Co., of Johnstown, Penn.

The Ajax Guard Rail

This is a self-supporting guard rail of cast-manganese steel, and the casting comprises the guard rail proper, its braces, and the tie-plates which support the track rail. The only additional parts are a spacing block at the middle, and a malleable-iron foot-guard at each end.

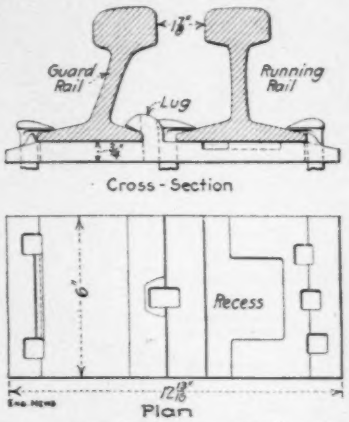


Fig. 1. The Morrison Rolled-Steel Guard Rail, Cambria Steel Co., Johnstown, Pa.

The face of the guard rail is a vertical web, reinforced by a wide top flange and vertical ribs. Slotted spike holes provide for adjusting the position of the guard in relation to the rail. The construction is shown clearly in Fig. 2, while Fig. 3 shows the guard rail in the track.

The rail is made ordinarily 9 ft. 10 in. long, straight for 3 ft. 10 in. at the middle and then flaring outward with a gradually increasing flare, the rail being set with 2 ft. 8 in. of the straight portion ahead of the frog point.

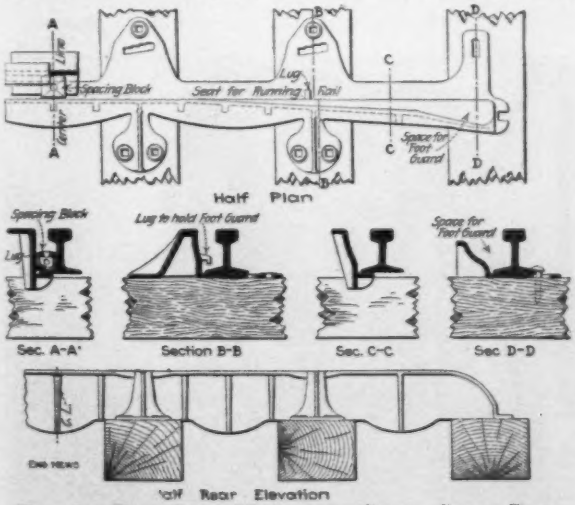


Fig. 2. The Ajax Manganese-Steel Guard Rail, Ajax Forge Co., Chicago, Ill.

It is considered that on the sharp curves of yard turnouts a greater length of straight guard rail is inadvisable, especially as engines designed for No. 8 turnouts are often operated through still sharper turnouts, which leads to distortion of the track.

A special feature is that the guard rails for use on heavy curves are made ¾-in. higher than the running rail, for the reason that an engine with long wheel-base will sometimes have such a heavy side thrust as to relieve the weight on the pony truck, so that the truck wheels may lift from the rail. The high guard rail will also engage the guide blind driving wheels. The principle is the same as in grooved rails for sharp curves on

Fig. 3. Front and Rear Views of the Ajax Guard Rail in the Track

street railways, which are made with the guard higher than the rail head.

This guard rail is made by the Ajax Forge Co., of Chicago, and is in use on a number of railways, particularly at large terminals. They are found to show very little wear after considerable service under severe conditions of traffic, and they require very little maintenance. In some cases, however, it is thought that there is little if any advantage in raising the guard rail above the level of the running rail.

The Morden Guard Rail

This also is a manganese-steel casting, but the guard rail proper is of heavy angle section with lugs by which it is secured to cast-steel chairs which carry the running rail also. Thus the only part made of the more expensive manganese steel is that which actually takes the wear. The foot guards are of malleable iron.

The guard rail is 10 ft. long, straight for 3 ft. at the middle and then curving out at each end on a radius of

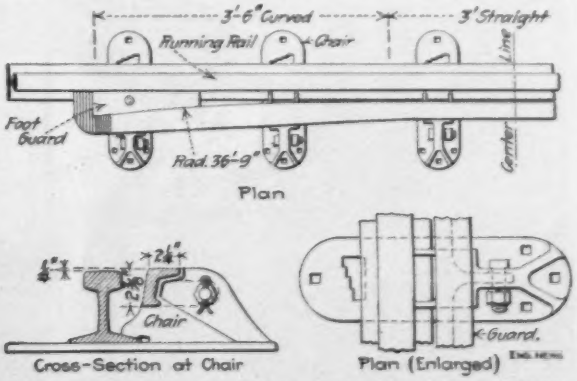


Fig. 4. The Morden Manganese-Steel Guard Rail, Morden Frog & Crossing Co., Chicago

36 ft. 9 in. The rail when in position is slightly higher than the running rail in order to take the lateral thrust to better advantage. This guard rail, shown in Fig. 4, has been used experimentally. It is made by the Morden Frog & Crossing Co., of Chicago.

New York Rapid Transit Railway Extensions*

By F. Lavis†

XII--Concrete Work

The total amount of concrete to be used on the whole of the subway construction is, of course, quite large, but speaking generally there is little of the work where there are large masses, or where a great deal is required at one time, so that there are no elaborate plants for turning it out in large quantities. Three general methods are used, a central mixing plant of comparatively small capacity, the material being hauled in motor trucks to the point of delivery into the forms, a portable or movable mixer at the site, and hand mixing on the planking of the roadway immediately over the work. This latter seems an anomaly in these days of the very general use of machinery; but in reality on account of the relatively small amount of material usually required to fill a considerable space in the forms, this latter method in many cases seems to be quite as economical and efficacious as any of the others.

Concreting Plants

The few specific plants and methods described below are fairly typical. On Sec. 8, 10 and 11, Lexington Ave., the concrete was all mixed dry in two 1-yd. batch mixers, at the 96th St. Dock on the East River, from whence it was hauled in wagons holding about 3 cu.yd. to the point at which it was to be used. The use of horse-drawn wagons prevented the addition of the water before hauling on account of the length of time required to make the trip. It was usually dumped on the street decking, water added, and the mixture shoveled into chutes directly into the work in the cut-and-cover sections, or delivered down the shafts into 1-yd. cars for the tunnels. These cars were hauled to the point where the material was to be used and there dumped directly when the material was placed in the floors or footings of the walls, or hauled up a short section of movable inclined track to a platform at about the level of the springing line, where they were dumped and the material shoveled into the forms for the arches and sidewalls.

In one case in the tunnels on Sec. 9, a timber platform was suspended at about the springing-line level from eyebolts, built into the concrete arch. The concrete was delivered into cars at the level of this platform at the shaft, and pushed along a track on it to the point where it was to be used. This required the permanent use of a considerable quantity of timber, however, and after a length of some 300 or 400 ft. had been built this way, a small traveler with an elevator was built to hoist the cars from subgrade level to the springing line. This was in a section where the rock required no support so that the whole section was clear. The platform of the traveler at the springing line reached across both tunnels and was located in the clear excavation ahead of the forms. The footings of the sidewalls were built first and kept ahead, and tracks

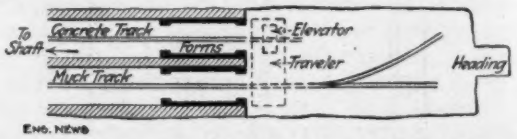


Fig. 83. Layout of Plant for Placing Concrete in Double-Track Tunnels, Lexington Ave.

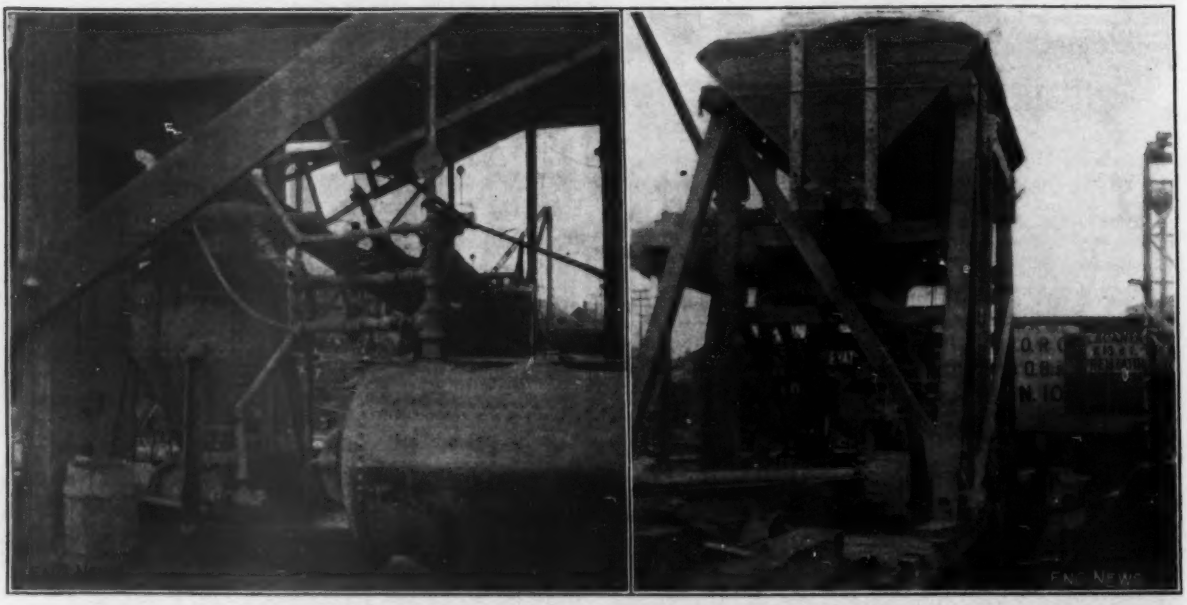


Fig. 84. Pneumatic Concrete Mixing and Conveying Plant for Harlem River Tunnels
(Mixer on left, bins on right.)

*Copyright, 1914, by F. Lavis.
†Consulting Engineer, 50 Church St., New York City.

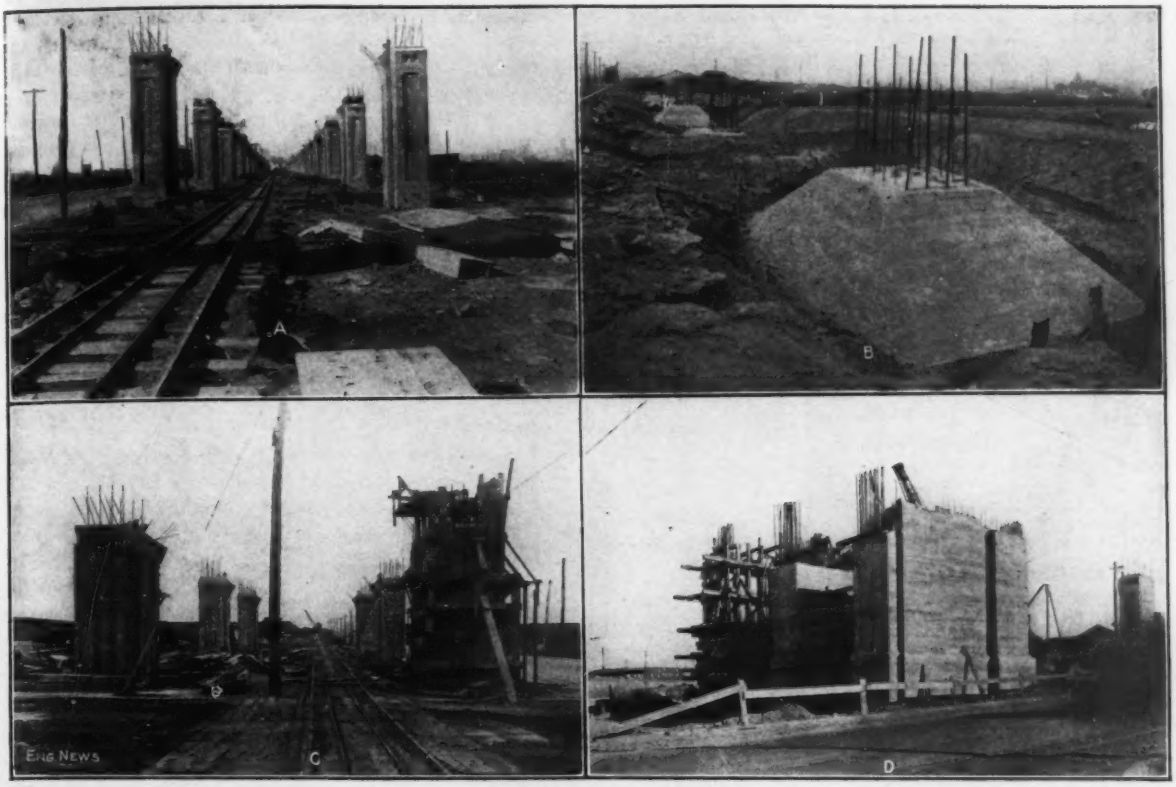


FIG. 85. VIEWS OF QUEENS BOULEVARD REINFORCED-CONCRETE VIADUCT DURING CONSTRUCTION
(A) Columns completed. (B) Foundation for columns. (C) Columns showing forms. (D) Abutment at New York end.

for both the traveler and the forms were laid on them. The track in one tunnel was used for concrete cars, and in the other for the muck cars. The concrete cars were brought in under the traveler, hoisted by the elevator to the upper platform, from which both arches could be reached. The general layout is shown in the sketch, Fig. 83.

Wooden and steel forms have both been used on all four of these sections; the general opinion seems to be that where there is a length of say over 300 or 400 ft. of lining all of the same section, steel forms of the Blaw type are cheaper and quite satisfactory. The Blaw forms keep their shape quite well under ordinary conditions; but they could not be used to advantage in the sections where continuous support of the ground by posts was necessary, and, of course, not at all in sections where posts had to be left in while the lining was placed and only removed after the arch had taken the weight.

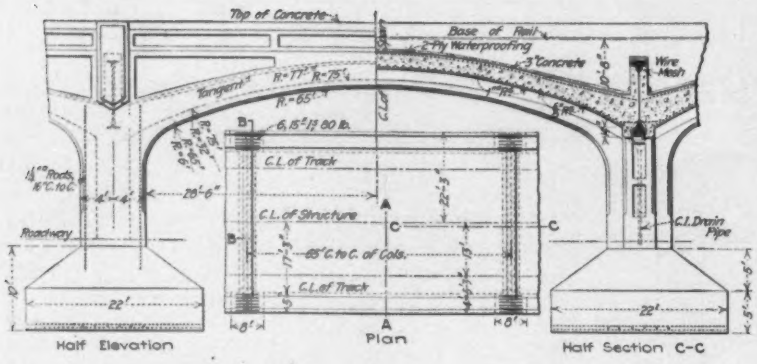
On Sec. 9 motor trucks were used for the concrete, thus permitting the complete mixing with water at the dock, which was possible by reason of the rapid means of transit these trucks provided.

On Sec. 12 a ¾-yd. batch mixer was used, set up along the side of the street and moved along as the work progressed, the concrete being mixed at the point where used. Blaw forms were used, but on account of the continually varying dimensions of structure, were found to be not as easily adaptable as on work where they could be used over and over again without change.

On Sec. 13 the concrete-mixing plant is located at the dock at the foot of 125th St., the average haul to the work being about half a mile. A 2-yd. batch mixer is used, arranged with the necessary bins, etc., for convenient feeding of the materials, and so as to deliver the mixed concrete about 10 ft. above the ground. Two motor trucks with self-tipping bodies holding 4 yd. each are used for hauling the mixed concrete to the work. The latter is mixed fairly wet at the mixer, and a little more water is added for cleaning as it is dumped; an air pipe is kept in readiness to be used if necessary, to help get it out and clean the wagon. This is just a short length of 5 or 6 ft. of inch pipe at the end of a hose, capped at the end and with small holes bored in it. It can be pushed into any mass which has shaken down so as to become a little tight and so start it. At the work when a section is ready for concrete, holes are cut in the wooden street decking at suitable intervals and a line of 8-in. conical sheet-metal spouts in 5-ft. sections is hung to lead from the hole in the decking to the forms. The sections are slung one below the other by chains. Over the hole in the decking is placed a wooden hopper 7x13 ft. and 2 ft. deep, into which the truck dumps its load and is away in about two minutes.

The hoppers are on skids and are not connected with the spout or the decking. They are moved by hitching them by a chain to a truck. The trucks make a round trip from the mixer to the place of dumping and return to the mixer in from 15 to 20 min.

On Sec. 15 there is a central mixing plant with a 1-yd. batch mixer. The concrete is carried in 1-yd. double-hinged bottom-dumping buckets, two of which are mounted on a flat-car; two cars are hauled together by a dinkey on 3-ft. gage track. The cars are arranged on the flat-car frame so that they can be dumped through it with-



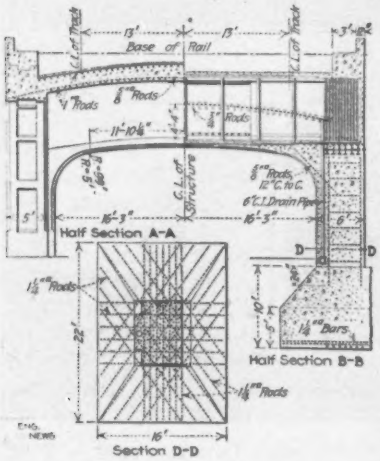


FIG. 86. DETAILS OF DESIGN OF TYPICAL SPAN, QUEENS BOULEVARD VIADUCT.

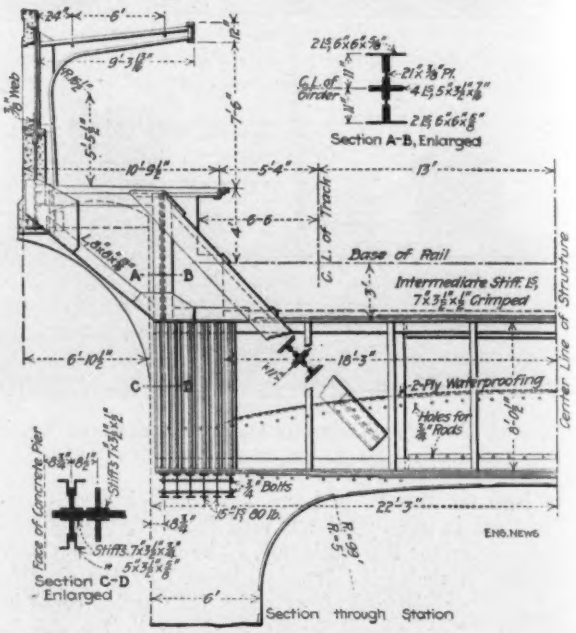
out removing them. On this section the work is only partially decked over and the track is laid over the open trench. The cars with the buckets are run to the point where the work is being done, spotted over the top of a chute and hopper and each bucket dumped in succession into it.

For the Harlem Tubes, the outer concrete, as has already been described, was mixed by machinery on a lighter and deposited by means of tremies. For the lining of the inside of the tubes, the compressed air or pneumatic system controlled by the Chicago Concrete Placing Co. was tried at the northerly end for a part of the section.

The views in Fig. 84 show the general layout of this plant, which it was expected to use for the lining of half the length of the tubes. It is installed on a platform built over the water. The materials are fed in the proper proportions from the overhead bins into the cylinder of the machine in half-yard batches. Water is added, from a pipe leading into the top of the cylinder at the same time as the dry material enters from above, the quantity being carefully measured, as it is of some importance to get the proper consistency. An air valve is then opened, and used as a blower to clean the gasket forming the seat of the top door which is then closed. Air is then admitted from the second valve over the top of the mixture to seal the top door, and apply pressure behind the mass, then the lower air valve opening into the elbow in the pipe just below the discharge at the bottom of the cylinder is opened, to loosen up the material as it feeds into the pipe, and both these last two valves are kept open until the drop in the pressure shows that the batch has been discharged from the end of the pipe.

Normally, very little, if any, trouble has been experienced in discharging the concrete at distances up to 500 ft., for which an air pressure of about 80 lb. is used and the material has been carried over 800 ft. in the work, but to do this the air pressure had to be increased to 100 lb. and there were some few difficulties which, however, should be overcome in similar work as the men get used to the apparatus.

On leaving the main cylinder the pipe runs horizontally for 25 or 30 ft., then drops vertically 50 ft. or so to the bottom of the tunnels, and then along the



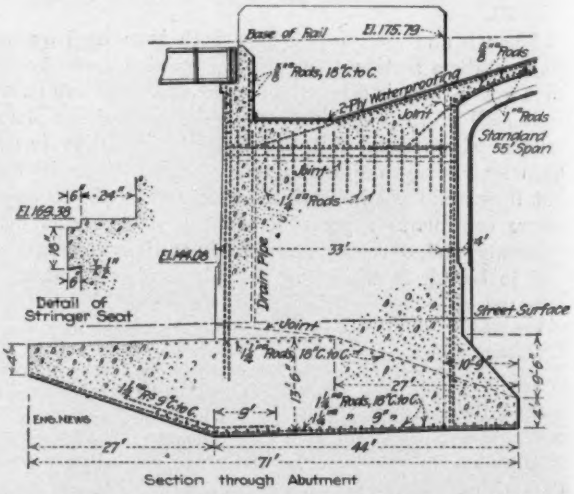


FIG. 87. SECTION THROUGH STATION AND DETAILS OF ABUTMENT, QUEENS BOULEVARD VIADUCT

floor to the point of discharge. Only the bottom of the tunnels was put in by this method, which for this kind of work probably has few advantages over any other method. In placing the sides and arch, however, which it

was expected to be able to accomplish at one operation, the method should have advantages if successful, as it would avoid lifting the cars or buckets up onto a platform and the necessary shoveling into the forms.

As many as 40 batches (20 yd.) have been placed in one hour but the average for an 8-hr. shift is not over 65 to 70 yd., due to delays for shifting forms, shifting the pipe, etc. The work is being prosecuted continuously day and night, three 8-hr. shifts being worked. The average amount of concrete placed is from 135 to 150 yd. per day of 24 hours.

The discharge pipe is 8 in. diameter, flanged and bolted, made of a very mild but tough steel, which is expected to have a life estimated by a capacity of about 4000 yd. passing through it, the present pipe, however, which has been used for the discharge of almost 2000 yd., is beginning to show some signs of wear. This was particularly noticeable at the bottom of the perpendicular drop, and a new bend made of extra-heavy cast-iron segments, bolted together to make a curve of about 5-ft. radius, was installed and seems to work satisfactorily.

Reinforced-Concrete Elevated Railway

A part of the elevated structure to be built between the Queensboro Bridge Plaza in Long Island City and Corona, is of reinforced concrete. This section, which is 4271 ft. in length, is that which traverses Queens Boulevard, a parkway 200 ft. in width and one of the main arteries of travel from New York City out into Long Island. It was desired to make this an ornamental structure, and the drawing reproduced in the first of this series of articles (Fig. 3) gives an idea of the appearance of the completed structure.

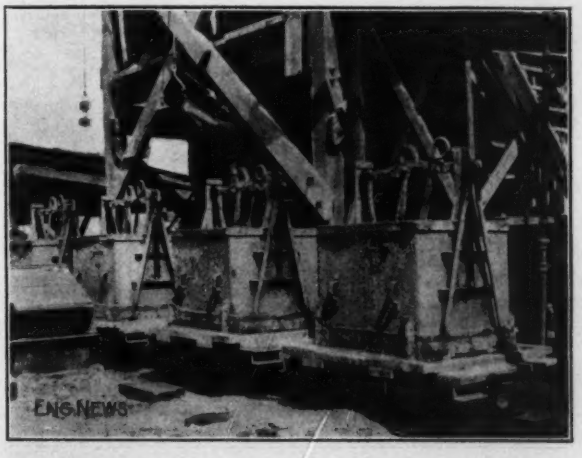


Fig. 88. Concrete Buckets about to Be Loaded

The views in Fig. 85 show the construction of the column foundations, the columns and the abutment at the New York end. A longitudinal section on the center line of the structure through the end abutment, is shown in Fig. 87, and longitudinal and cross-sections of the main viaduct arches and piers in Fig. 86. The type of stations, of which there are three in this reinforced-concrete section, is shown in the perspective drawing already referred to and the details, and particularly the overhang for the platforms, in Fig. 87.

As will be seen by the photographs, the columns were first built up to a point slightly above the springing line of the arches, then the heavy cross-girders at each bent were placed in position, after which the arches and parapet walls were poured.

A central mixing plant for the concrete was established near the New York end with a 1-yd. batch mixer operated by an electric motor with chain drive. The concrete was distributed from this point by dinkeys and trains of small four-wheel flat-cars, each carrying a single 1-yd. double-hinged, bottom-dumping bucket. A standard-gage railroad track was first laid the whole length

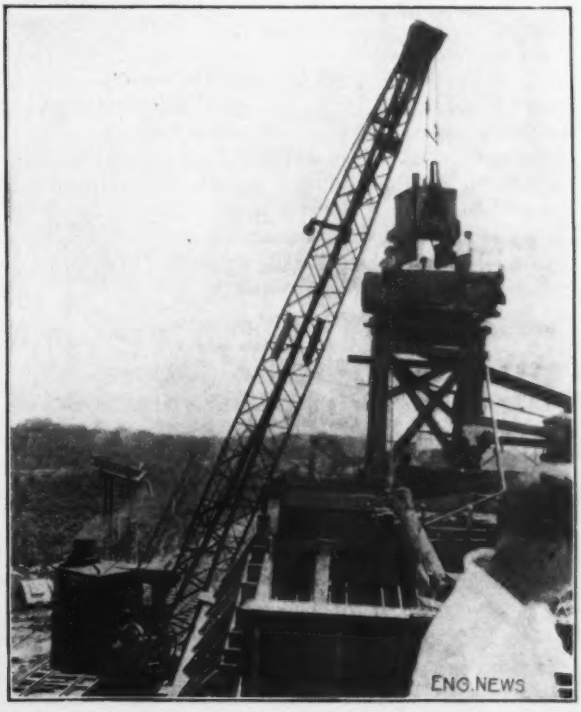


Fig. 89. Lifting Concrete Buckets into Place, Queens Boulevard Viaduct

of the work, between the two rows of columns. This was used for the operation of two 15-ton locomotive cranes, and for the distribution of material. The cranes were used for various purposes in place of derricks, and for handling the forms and the concrete in the buckets, the latter being picked up off the cars and dumped directly into place. The concrete train and dinkeys were operated on the 2-ft. gage track laid in the center of the standard gage, during the construction of the piers, five cars being used in each train.

As soon as the construction of the columns was finished, the cross-girders, which weighed 27 tons each, were placed on top of them, being handled by a derrick car, as they were rather too heavy for the locomotive cranes.

For the construction of the arches, a standard-gage track for the two cranes was laid just outside the westerly row of columns, and a double-track narrow-gage line for the concrete train outside of this. When concreting from 1000 to 2000 ft. away from the mixer, three trains of five cars each were used to distribute the concrete. Clean, rounded gravel of fairly uniform size, graded from $\frac{3}{8}$ to $1\frac{1}{2}$ in., is used for the aggregate, making a mixture which will probably give good results for the proposed hammered finish for the surface.

It will be noted from Fig. 86 that the arches curve both ways, giving somewhat the effect of a dome. The central third of each arch extending right across the structure, together with a part of the two side parapet walls, was first poured, then when that had set, the two sides between the central third and the cross-girders were poured together. The forms are left in place 28 days and it is expected to use each set of forms three or four times.

For pouring the arches, hoppers are erected above them into which the buckets (Fig. 88), lifted off the cars by the cranes, are dumped (Fig. 89). The concrete is then distributed from the hopper by short chutes as required. For the central section one hopper is used, for the end sections two hoppers, one for each; the central section is placed without top forms, but these latter are required for the steeper slopes of the two end sections.

It is proposed to hammer-finish all exposed concrete faces, using a patent-hammer for all plain surfaces and a bush-hammer for recessed panels. The ends of the cross-girders on top of the columns and the longitudinal panels of the parapet walls are to be faced with colored ornamental tiling.

This is the last of the 12 articles on the "New York Rapid Transit Railway Extensions." The respective titles and dates are as follows:

I.—"History and Extent," Oct. 1.
II.—"Organization and Personnel of the Engineering Staff," Oct. 8.
III.—"General Arrangements for Construction," Oct. 15.
IV.—"Design of Structure and Track," Oct. 29.
V.—"Ventilation, Drainage and Waterproofing," Nov. 5.
VI.—"Sewers, Pipes and Conduits," Nov. 12.
VII.—"Methods of Timbering to Support the Street Surface on New York Subway Construction," Nov. 26.
VIII.—"Excavation," Dec. 3.
IX.—"Underpinning Buildings along the Line," Dec. 10.
X.—"Tunnels in City Streets," Dec. 17.
XI.—"The River Tunnels," Dec. 24.
XII.—"Concrete Work," Dec. 31.

Ocean Storms at Seabright, N. J.

That Seabright, N. J., is at the mercy of northeast storms is evidenced by the accompanying views of the damage wrought on Dec. 5-6. The force of the water and the weak resistance offered by the puny shore bulkheads provided are plainly shown.

About a year ago two other ocean storms, also accompanied by record tides, all but obliterated the Seabright beach and damage to abutting property amounted to $600,000. At that time ENGINEERING NEWS made an investigation of the conditions at Seabright, and published the findings in the issue of Jan. 8, 1914, p. 102. Practically the same lack of protection exists there today.

A conference was held at Trenton, N. J., on Dec. 16, to devise means for protecting the state seaboard. It was attended by delegates from most of the shore towns.

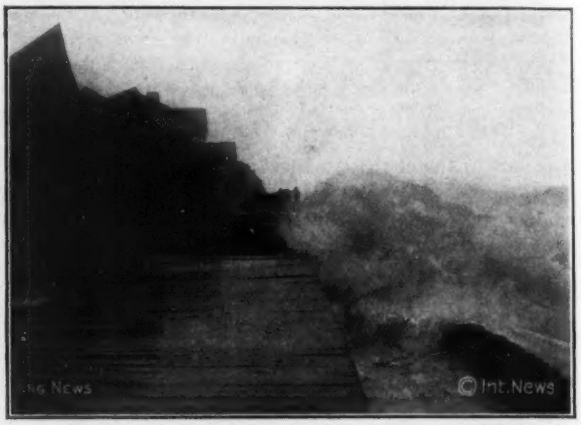


FIG. 2. DAMAGE CAUSED BY LACK OF ADEQUATE GROIN PROTECTION
(Note typical bulkhead at right, with waves dashing over it.)

FIG. 1. PROXIMITY OF COTTAGES TO DEEP WATER
(A flimsy groin in foreground; shore bulkhead gone at right; waves pounding shore-property bulkheads.)

Widening a Business Street at St. Paul, Minn.

A municipal improvement of an unusual character, which is now being carried out in St. Paul, Minn., is the widening of a street through the business part of the city. Robert St. extends north from one of the Mississippi River bridges, and lies in the retail shopping district; it has a heavy team traffic, and is occupied by a double-track street railway for six blocks. The width was only 55 ft., so that traffic was badly congested, and in March, 1913, the City Council passed an order for widening it to 75 ft. from 2nd St. (at the end of the bridge) to Central Ave., a distance of 4257 ft., or about 15 city blocks. Central Ave. is a mall or boulevard 112 ft. wide, which runs in front of the State capitol and will become a part of the general approach scheme.

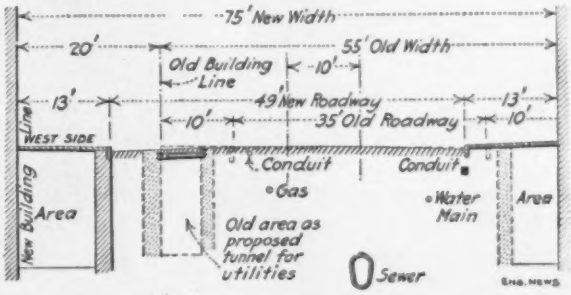
The work is in progress now on the first six blocks, to 8th St., beyond which the street is built up largely with rooming houses and small stores. The accompanying cross-section shows the general arrangement. It will be noted that it is proposed to cover the old subsidewalk-area space with a concrete roof and utilize this as a tunnel for public utilities. This is conditioned upon the public-utility corporations agreeing to use the space, which it seems they will not do.

The widening is done entirely along the west side. Fortunately all the buildings were old, from three to six stories high, and mainly of brick construction with wood floor framing and with light interior iron columns in the stores, etc. The only new building affected had been designed with a view to this change, and had a steel frame at 20 ft. back from the old street front to allow for removal of the outer panel. Under these conditions, it was practicable to cut off 20 ft. from each building and put in a new front of modern type, thus greatly improving the general appearance of the property. Eventually, much of this property will be replaced with larger modern buildings. A 16-story frame building now being built at 4th St. replaces a six-story brick building and its construction was delayed until the widening of Robert St. was undertaken.

All alterations were required to be approved by the Building Department. In the residential blocks, part of the widening will simply take gardens and open ground; some of the buildings may be altered and others may be moved back to clear the new street line.

The total estimated cost of widening the street is $887,000. This includes cutting off 20 ft. from the buildings and replacing a new front; also the value of the 20 ft., the repaving of the street, moving sidewalks, lamps, etc., and consequential damages. Of this amount, $392,000 was assessed back against the property on the west side of the street as benefits, and a bond issue was made to take care of the balance. The assessments were spread 150 ft. each way from the old street lines. The benefits assessed amounted to as high as $300 per front foot between 4th and 5th Sts. The property on both sides was assessed, although that on the east side incurred no expense for alterations.

The property owners in general accepted the conditions in view of the eventual benefits. About 19 appeals were made from the assessment. Only ten of these went into court and six of them have been settled, the city winning three and losing three cases. One of the interesting features in connection with the assessment was that the Merchants Bank, a six-story brick building, was allowed $34,000 damages for moving the front back 20 ft., notwithstanding that the owners were simply waiting until the Robert St. widening was completed, to tear down the old building and put up a new 16-story building. The assessments are payable in five annual installments with interest at 6%. The bonds are taken up as the assessments are paid. Damages were paid in several instances to tenants for injuries to business, but these damages were not large.



THE WIDENING OF ROBERT ST. AT ST. PAUL, MINN.

The work was planned under the direction of Oscar Claussen, Commissioner of Public Works.

It is of interest to note that in 1912 a proposition to widen this and other narrow streets in the business district by forming arcades (for sidewalks) along the street fronts of the buildings, was made by Geo. H. Herrold, Assistant City Engineer. The store fronts would be moved back about 15 ft., the supporting columns under the front wall being replaced (where practicable) by columns of uniform design and spacing, so as to give an improved architectural effect. The roadway would then extend the full width between building lines. It was suggested that such arcades or covered walks would be beneficial to the public and the stores, and would not affect the buildings (except at the street level).

Enforcement of Ordinances by Public Officials—The Appellate Court of Illinois, in a recent decision, declared that a public officer in enforcing an ordinance must act as the ordinance provides, and has not discretionary powers. A theater building was under construction which embodied violations of the city ordinances, and the work was stopped on this account, but the permit was not revoked by the Commissioner of Buildings, and work was afterwards permitted to be resumed. Suit was brought to compel the Building Commissioner to revoke the permit, to stop the work, and not to issue a new permit until changes had been made to comply with the ordinances. The Circuit Court awarded a writ of mandamus to this effect, but instead of complying with this, the matter was taken to the Appellate Court, which has affirmed the action of the lower court. In the light of this decision, municipal officers are not free to decide for themselves whether or not to fulfill the duties explicitly prescribed for them in the ordinances. The decision says:

> Under the provisions of the ordinances set out in the petition, there is, in our opinion, no liberty or power of acting conferred upon the Commissioner of Buildings upon his own judgment as to what action is just and proper under the facts and circumstances presented in the petition, for the ordinances clearly direct him as to his course of action. Section 236 says: "If the work . . . shall be conducted in violation of . . . this chapter, it shall be the duty of the commissioner to revoke the permit." Section 203 provides that whenever it shall be found that a structure is being built "in violation of any of the provisions of this chapter, the Commissioner of Buildings shall forthwith notify the owners," etc.; if at the expiration of the time specified in the notice the person so notified shall have refused, neglected or failed to comply with the request made in such notice, it shall be the duty of the commissioner to proceed forthwith to tear down or cause to be torn down such structure. These provisions are mandatory and specific, and leave no field open for the exercise of personal judgment. They command ministerial acts to be done by the commissioner.

Construction Camp, Elephant Butte, N. M.

By J. Dale Graham*

SYNOPSIS—Description of the construction camp of the United States Reclamation Service at the Elephant Butte dam; hospital department; preventive measures, which include the physical examination of every employee, vaccination against typhoid fever; sanitary features of camp; garbage and night soil disposal and fly prevention.

The Elephant Butte camp, New Mexico, is composed of 3000 inhabitants, 1200 of whom are employees of the Reclamation Service. The camp is fortunate in being considerably removed from any large city, thereby greatly limiting the danger of contagion through carriers. There are, however, some nearby small villages which have menaced the usual good health of this camp. Experience has shown the value of extending to these villages and towns some manner of inspection (however unauthoritative).

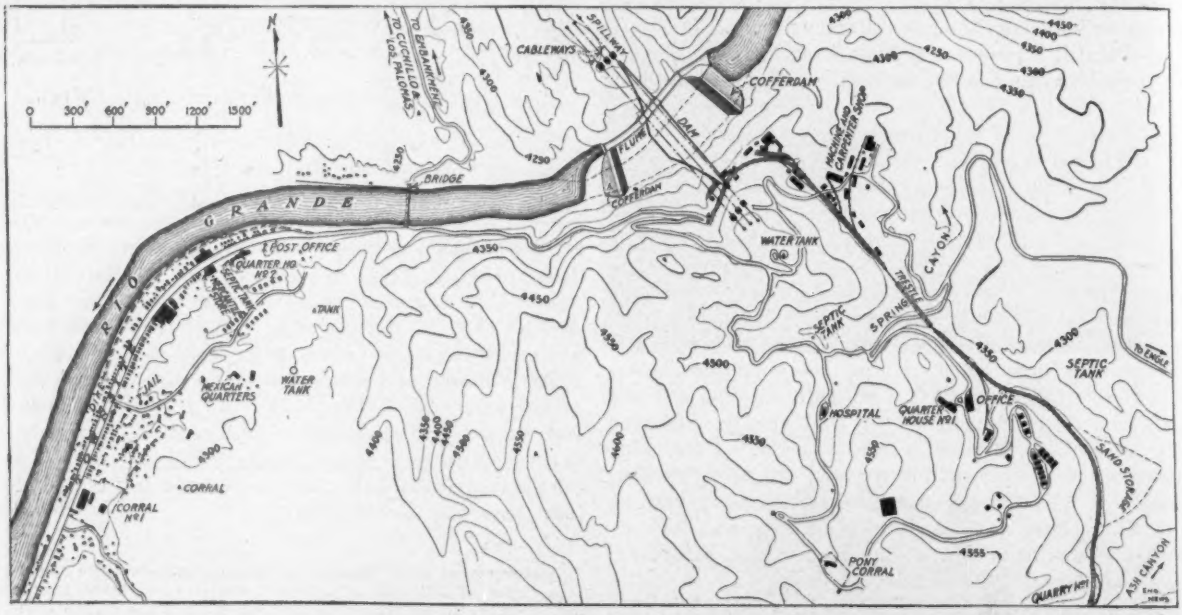


FIG. 1. MAP OF THE ELEPHANT BUTTE CONSTRUCTION CAMP AND SURROUNDINGS, NEW MEXICO

DESCRIPTION OF CAMP

Geographically the camp is divided into an "upper town," where the engineering and office force lives, and a "lower town," for the foreman, mechanics and laborers, the latter town being further divided into an American and a Mexican quarter (see map, Fig. 1).

UPPER TOWN—The buildings of interest are the main office, quarterhouse, mess hall, chemical laboratory and cottages, all of pebble-dashed adobe construction (Fig. 2). The main office, 36x110 ft., is the center of all executive work. The quarterhouse, 34x145 ft., two stories, has accommodations for about 50 persons, and is a stopping place for transients, though in no wise considered a hotel.

This building is equipped with steam heat, electric lights, bath and sewer connection; it has card, reading and billiard rooms, and large dancing floor. The mess hall is 36x94 ft., with seating capicity for 75; it has refrigerator rooms, and is subject to sanitary inspection. The 14 cottages, situated on a small plateau overlooking the reservoir, are of three, four and five rooms, well finished, and equipped with electric lights, bath and sewer connection.

LOWER TOWN—The buildings of interest are the commissary, mess, mechanics' quarters, bunk houses, moving-picture theater, churches, school houses, accommodating 420 pupils, and a large number of cottages, government and private (Fig. 3).

The mess hall is 42x126 ft., with seating capacity of 200; it is doubly screened at entry ways, has good ventilation by means of fans and louvers, and is subject to inspection. A hall, 65x42 ft., is a part of this building, and originally was intended as a dining room, but is now used for a Y. M. C. A. headquarters.

The commissary, 57x77 ft., is under government management, and is the only store. It supplies the general mercantile needs of the people at reasonable prices. Vegetables and fruits are kept in season. The meat market, a part of this building, is well screened, and subject to rigid inspection. The ice house and cold storage are also under the same roof. The fact that it requires ten men to do the work connected with the commissary gives some idea of the large volume of business.

The mechanics' quarters, 26x150 ft., 2 stories high,

*Camp Physician, Elephant Butte, N. M.

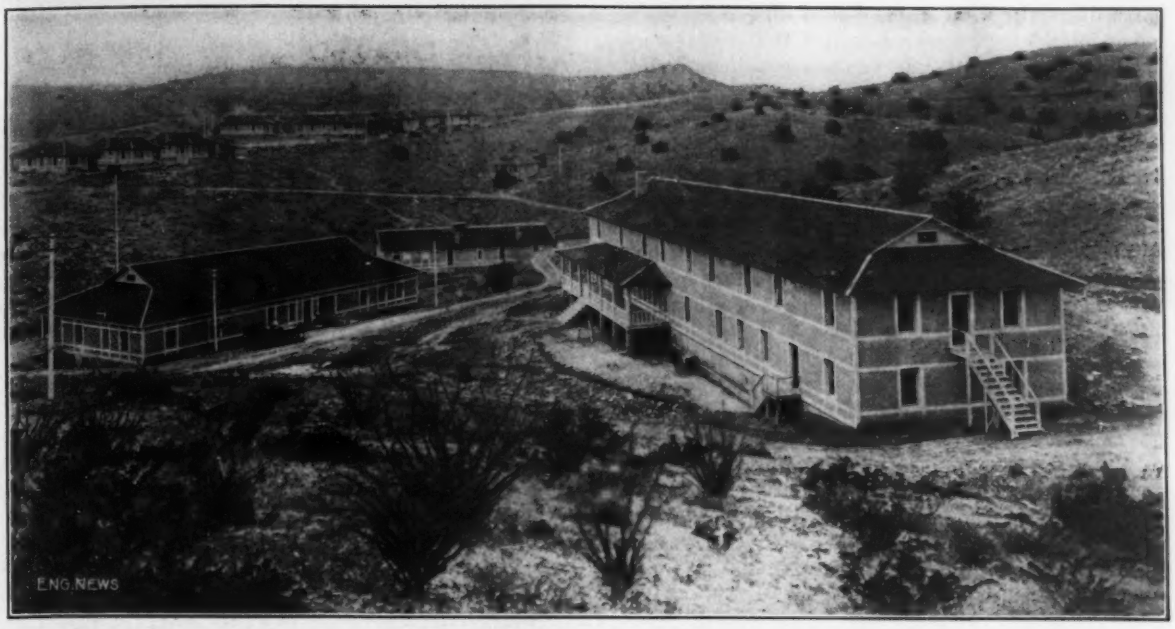


FIG. 2. UPPER TOWN, ELEPHANT BUTTE CONSTRUCTION CAMP

has 32 rooms accommodating 66 men. A small wing of this building, 16x36 ft., is equipped with 12 shower baths, the usual urinals and lavatories, discharging into a septic tank. This building is equipped with steam heat and electric lights.

The bunk houses in the American quarter are of the tent-house style, 14x16 ft., well screened, and particularly well adapted to the climatic conditions, so far as the comfort of the men is concerned, but ill advised from an economic point of view on account of much necessary repair from time to time. These tents accommodate from two to eight, according to the necessity. Four bunk houses of

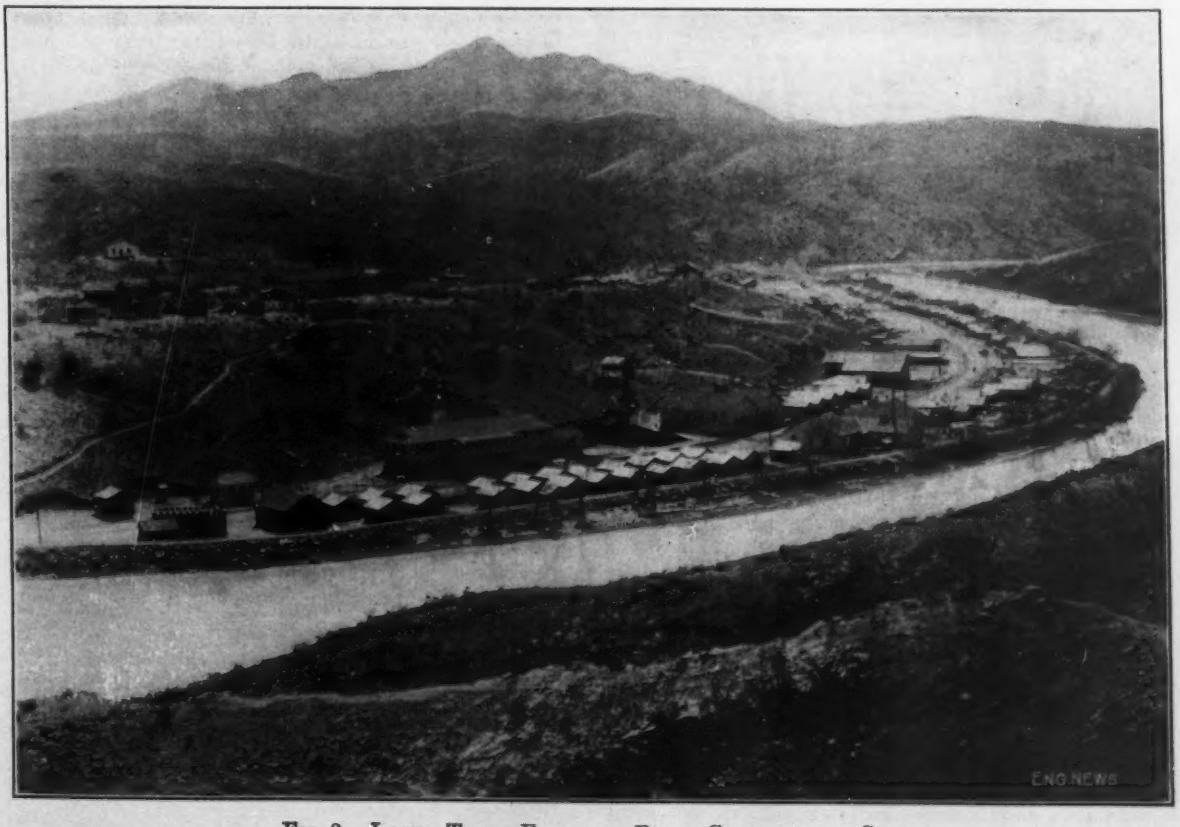


FIG. 3. LOWER TOWN, ELEPHANT BUTTE CONSTRUCTION CAMP

the same style, with double-decked cots, accommodating eight to each tent, are provided for Mexican laborers.

Besides these tent-style bunk houses there are three houses of frame construction, each accommodating 64 men in double-decked cots. These buildings are provided with good ventilation by means of swinging, side-hinged windows between each tier of beds, and by louvers. All permanent bunk houses are screened and provided with electric lights, water and shower baths.

In the American quarter there are three bath houses, 12x16 ft., accommodating the families of this part of the camp. They are equipped with a hot-water heating apparatus, two showers and one tub.

The Reclamation Service has built 26 tent houses and cottages for rental purposes, none of which is ever without occupants. The moving-picture theater and the ice-cream parlor are operated by the Service, and are built solely for the entertainment of the camp. Sufficient revenue only to meet expenses is expected.

Hospital Department

As will be seen from the map, the hospital is somewhat isolated, though conveniently situated near the center of construction activities. The building (see Fig. 4) is of pebble-dashed adobe, well finished and equipped. For the

Fig. 4. Hospital Building, Elephant Butte Camp

care of the sick and injured, there are two private rooms and a ward. (A well regulated field hospital should have two or three private rooms on account of the absolute necessity of isolation in many cases.) Beds are furnished for twelve, but more can be accommodated.

The arrangement of the building is such that the reception room can be utilized as a second ward, as has been necessary a number of times on this work. The dining room, kitchen and steam-heating apparatus are in the basement. The operating room is well equipped and splendidly lighted. The dispensary is well filled with such medicines and supplies as are required, besides a few drug sundries, the latter articles, however, being handled chiefly by the commissary.

Besides the physician and nurse, the force includes an orderly and a housekeeper (cook). A contract is also in force with a consulting surgeon, who makes visits on request, assisting in any manner of operation at one specific price.

Stretchers and crutches are stationed at convenient points about the work, as are also small first-aid emergency kits, containing peroxide, cotton and bandages. If the case is one in which actual hospital confinement promises a salutary effect in reducing the days incapacitated to a minimum, the patient is required to remain. Otherwise, he may go home, reporting as ordered for treatment. However, to get credit for meals he must take same at the hospital. If incapacity from injury extends to or beyond 15 days, claim is made for compensation, as provided under the Congressional law.

Immediate report of injury is made on specific blanks, giving name, age, kind of work, salary, character of injury, witnesses and circumstances attending the inquiry. A duplicate of this report is retained. An employee laying off on account of sickness or injury must have an order from the physician before he will be allowed to return to duty.

The physician makes to the engineer, ten-day, monthly and yearly reports, covering the health of the camp, sanitation, number and ratio of days lost on account of injury and sickness, and points of interest in the general management of his department. Drugs and hospital supplies are purchased in large quantities. Duplicates of all orders, invoices and reports are kept on file.

A compulsory deduction of $1 per month is made from each pay check, which entitles the employee to all reasonable dispensary or hospital service. It is found that there is practically no disposition to abuse the privilege. At this time the hospital fund is showing a balance in its favor.

Preventive Measures—The business of the camp physician is not so much to treat the sick as it is to create conditions which will keep sickness at its lowest ebb. To this end, for instance, with the first suspicion of a disease from which there may be possible dissemination, precautions are taken at once without waiting for a positive diagnosis. If the suspected disease is one from which contagion may occur from human wastes, a flyproof receptacle, usually a garbage can, is placed conveniently near, into which all body wastes are thrown, where they receive special treatment before being carted away.

Typhoid prophylaxis through vaccination has been introduced. It may be of interest to note that not an employee has lost a shift from its effect.

Each applicant for work is given an employment slip, which must be O.K.'d by the physician before his name can appear upon the time book. Applicant's age and conjugal condition are taken, and a record made of the notification address, to be used in event of serious sickness or injury.

Physical examination, as practiced here, is more in the nature of an inspection. Gait is noted, eyes, tongue and skin inspected, and examination made for rupture and heart disease. If such examination suggests unfitness, a more thorough one is made. Special attention is given to employees requiring special standards.

It has been urged that contractors would be handicapped in securing labor if insistence was made upon examination as to physical fitness. To disprove this it may be stated that since this system was installed, a little over two years ago, only three out of a total of over 3000 applicants have refused to be examined. There have been as many as 347 examined in one month without any objection whatever. A very few make a mild protest, but a little tact overcomes this.

A matter having bearing both upon the economic as

well as the health feature may be mentioned here. There has been a determined effort in this camp on the part of the construction engineer to limit to the very minimum the importation of liquors. The effort has yielded a fine return. There is practically no drinking, and a drunken man is so rare an exception as to occasion great surprise. It is generally known throughout the camp that drunkenness or intemperate drinking will result in the dismissal of an employee. Early in the work it was stated that such strict rules would handicap the Service in securing workmen. It seems to have had the opposite effect.

Sanitary Department

The question of sanitation at Elephant Butte has naturally resolved itself largely into a relentless war upon the fly, and the efficient removal of stable, human and kitchen wastes. In this camp a stable owner is required to keep his corral well cleaned, failure resulting in the

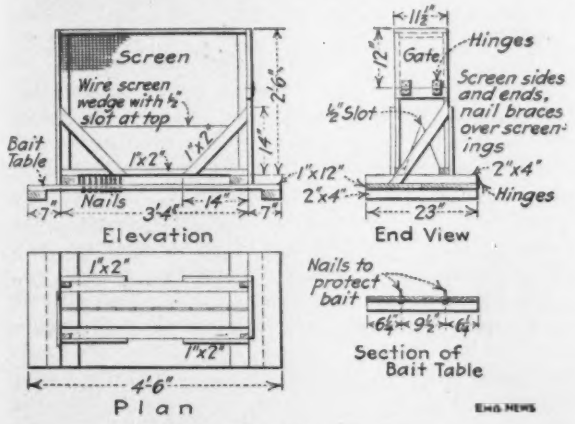


Fig. 5. Fly-Trap Details

work being done for him at his expense. The second offense cancels his permit to keep horses.

The matter of abolishing all private corrals in this camp is under advisement. Should this be done, persons who still desire to keep horses will be required to stable same in the government corral, for which a maintenance charge will be made. Hesitation along this line arises chiefly from the fear that such drastic action might affect the labor question, on account of the fact that a great many of the laborers are from the villages and ranches at a considerable distance, and come to camp in wagons.

However, it is believed that this course would effectually do away with the fly nuisance. It is noted that fly traps at the government corral catch but few flies, the reason being that the wastes are carted off every morning and there are no breeding places. It is also to be noted that at the upper camp, where there are no corrals, flies are so scarce that screens are almost unnecessary.

Fly traps are placed here and there about the camp, and in this way millions of flies are caught. These traps are put in place at the very earliest moment of spring, when flies begin to breed. Fig. 5 shows a trap of great fly-catching capacity. It is believed that the ceiling of these traps should be painted white and the floors of a dark color, carrying out a little further the idea that the fly after feeding on the bait will have just so much more light above to aid in his entrapment, as, after feeding he moves to the point of greatest light.

Garbage Disposal—The disposal of garbage and general camp wastes in a camp composed largely of single men in bunk houses, becomes a rather simple matter, but where a camp assumes the nature of a small city of 2500 people, chiefly foreign, where you have all the problems of village sanitation except law enforcement, you have then confronting you a complex problem.

Some 150 garbage cans are stationed about the camp, supplying 524 families. All camp refuse, except a part of the kitchen garbage, is dumped into these receptacles and carted to a specific dumping yard, at which point it is burned. All such wastes are removed by a man who is paid a small salary, but who depends chiefly for his income upon the food value of the slops, which he removes to a remote points and feeds to hogs.

It is believed that the garbage cans mentioned are a very small source of fly breeding, for two reasons: First, the frequent removal, and second, that practically all cans are used in the disposal of a great amount of wood ashes. Just how to keep lids on garbage cans is as yet a problem. If each family had an individual can, responsibility could be placed and the solution would be easy, but since garbage cans are community affairs, no one family can be held accountable.

Night-Soil Disposal—The location of the greater part of this camp is such that a complete sewer system with septic tanks and filter beds is impracticable, although desirable. The only disposal practicable is by means of the ordinary privy vault. This has necessitated the building of many privies.

At first these were built on ordinary lines with screened gables and screened doors, and self-closing lids. The latest privy design has such a seat that fouling, ordinarily a source of much trouble, is improbable. A solid door, hung inside, now replaces the screen door, which, when closed, keeps the vault fairly dark, so that flies attracted by odors are found near the roof about the screen.

Such a disposal of night soil is admittedly far from ideal, but it seems the most practical method under existing conditions. Privy vaults are treated frequently with chloride of lime. If ground water rises in them, the surface is floated over with crude oil. If particularly malodorous, crude carbolic acid is used.

Inspection—The camp is policed daily by a sanitary officer, who is responsible to the camp physician. This inspector's duties include attention to drainage, the treatment of stagnant pools with crude oil, the destruction of causes of malodors, attention to closets, the spraying of bunk houses with a 10% solution of carbolic acid and Vermin-go, twice monthly.

Where fumigation is impracticable, and such is the case where construction is being pushed with three shifts, the use of Vermin-go is very effective in abating a nuisance from insects, especially bed bugs. In one of the bunk houses the sprinkling of formalin upon the floor has been used apparently to a good advantage in driving away insects of various kinds, and as a reoderant.

Sewerage and Drainage—The camp, as will be seen by the map, is well drained, except a part of the residence section of the lower town, which is so flat and of such extent that sewerage is impracticable. For this part of the camp a system of open drain ditches for surface water is provided, which receive careful attention from

the sanitary officer. As before stated, sewage from the mechanics' quarters discharges into a septic tank. The upper town discharges its sewage into a septic tank with filter beds.

Amusements

Realizing that a contented employee renders more efficient service, the question of amusements has received considerable attention in this camp. There is a paid Y. M. C. A. secretary, who devotes a large part of his time to the creation of amusements. A high-class amateur orchestra gives frequent free concerts; baseball teams have been organized; frequent dances are given at both camps; tennis courts and croquet grounds are maintained; a boy-scout class gives diversion to the boys who have in ordinary camp life little to amuse them; each camp has a pool table, and a reading room. Also, as before mentioned, there is the moving-picture theater and the ice-cream parlor. Secret orders have built lodge halls.

Conclusions

Three years of experience in this camp has led the writer to the following conclusions:

That anything tending to create a better moral or sanitary environment increases the efficiency and output of the employee.

That the price of good sanitation is an eternal fight—a continuous campaign.

That good sanitation, even though expensive, pays a good return—besides it is humanitarian.

That perfect disposal of camp wastes will produce the millennium in camp life—a flyless camp.

That liquors are not only useless and undesirable in camps, but a real detriment from every point of view.

That examination as to physical fitness is not only practicable, but advisable.

That under average conditions private stables should not be maintained, and that there must be an eternal fight for cleanliness.

An Exhibit of Modern Street-Cleaning Apparatus: Refuse Collection

Supplementing the article and illustrations in Engineering News of Dec. 3, pp. 1139-1143, describing the exhibit of street-cleaning apparatus held in New York City, Nov. 23-29, under the auspices of the New York Street Cleaning Department, of which John T. Fetherston is Chief, we present herewith some illustrations and brief descriptions of special apparatus for refuse collection.

Figs. 1 and 2 show two styles of dust- and odor-proof wagons for refuse collection, such as have been used in German cities for at least ten years. They are made by Anton Fügert, Karlsbad-Fisshern, and were exhibited by H. Kastor, New York City, American agent. In the wagon, Fig. 1, the refuse is dumped into the rectangular cans hung on the sides, which are hinged to the wagon body, so that in lifting the cans up the covers of the cans and those of the wagon body open simultaneously and the material is handled without exposure to the air. The wagon itself has a bottom-dumping arrangement. Fig. 2 shows a truck with steel cans which are designed to be lifted off and dumped into a refuse destroyer.

Fig. 3 shows a type of odorless, dustless dump cart with can-dumping device similar to that used in the wagon shown in Fig. 1. This was exhibited by the City Street Cleaning Department and was made by Charles Putzel, of New York City. Other forms of dustless wagons had canvas tops. Obviously, any and all of them are great improvements over the open dump cart, which is now

Fig. 1. Ash and Refuse Collection Wagon of the Dustless, Odorless Type Used in Europe

FIG. 2. REFUSE WAGON TRUCK WITH CANS WHICH CAN BE LIFTED OUT AND DUMPED

almost wholly used in New York City for ashes and street refuse, and frequently for garbage.

Fig. 4 shows a pick-up can for street sweepings, made by the Tarrant Manufacturing Co., Saratoga Springs, N. Y. The hood-shaped funnel scrapes the pavement and refuse is swept into it. It is then lifted by a double lever

FIG. 3. DUMP CART FOR REFUSE COLLECTION, RECENTLY INTRODUCED IN NEW YORK

to dump into the can, making a vast improvement over the old-style hand shovel, still used by sweepers in most cities to pick up street refuse.

FIG. 4. PICK-UP CAN MADE BY THE TARRANT MANUFACTURING CO., NEW YORK CITY

A Railway Mail-Transfer System for collecting and dropping mail bags from trains has been adopted for the Chicago and St. Louis line of the Chicago & Alton R.R. At each mail exchanging station there will be a shallow concrete trough about 150 ft. long, with the edge alongside and above the track and the side inclined away from the track. This is to receive the bags dropped from the mail cars. Above it is a platform carrying the mail cranes to which are attached the bags to be picked up by the trains. The crane has two horizontal arms, attached to the top and bottom of the bag. There is a crane for each bag and as many as 12 bags can be taken by one train.

A special feature of the system is that the mechanism on the car is operated from one of the axles and is thrown into gear by means of a track trip so that it is independent of the attention of the mail clerks. The trip is set about 400 ft. from the trough and, as soon as this has tripped the lever on the car, the mechanism opens the door, swings out the arms for collecting the bags and also swings out the delivery chute containing the bags to be dropped. The chute in its delivering position is inclined about 45°, and projects over the concrete trough, so that the bags slide out and (with a very slight drop) are caught in the trough.

When the series of operations is ended, the mechanism comes to a stop automatically. When the lever is tripped a gong is sounded in the car as a warning to the mail clerks to stand clear. A lever in the car provides for making the mechanism inoperative if a station is to be passed without exchanging mail, and it serves also for reversing the gear to enable the car to be operated in either direction. The apparatus is made by the Hupp Automatic Mail Exchange Co., of Chicago.

Preliminary Report on Emscher Tanks and Kindred Sewage-Clarification Processes*

By Prof. Dr. K. Thumm and Prof. Dr. Eng. C. Reichle†

(1) The Formation of Acid Sludge in the Sludge-Digesting Chamber

As is well known, good Emscher tank sludge has a deep black color given to it by ferrous sulphide, and will naturally react alkaline, as it is impossible for ferrous sulphide to exist with free organic acids, as occur in sludge. It has a peculiar, not disagreeable, odor, somewhat like sealing wax, and is easily drained. The water contained in this sludge, which can be easily filtered off through filter paper, is more or less clear and colorless, does not smell putrid, contains ammonia and free carbonic acid, and reacts alkaline, as all normal, clarified or raw sewage does.

But occasionally the sludge from Emscher and similar clarification plants is of an altogether different quality, especially if it has been left in the sludge chamber for a few months. It is not black, but yellow, like milk-feces, grayish yellow or gray, has an evil smell, is very difficult to drain, has a distinct acid reaction, containing none or very little ferrous sulphide. The water contained in such a sludge has some ammonia, but has, like the sludge, a more or less but always distinct acid reaction, and finally the water as well as the sludge in the whole chamber will show this acid reaction.

Emscher tank sludge drawn from tanks that are in the process of ripening has, like the above described acid sludge, a gray to gray-black color, but the reaction of this sludge and the water in it is alkaline. The water is easily filtered off, the nearer ripe the tank is the easier the sludge can be drained.

With the preponderance of carbon hydrates and a small amount of nitrogen combinations, such as ammonia and other bases, acid sludge must be expected with every method of separate sludge digestion, and later on, as the acid reaction progresses, also acid water. A preponderance of nitrogen combinations or other acid-neutralizing matter assures the formation of alkaline sludge and alkaline water in the sludge-digesting chamber. From sludge and water, which have only small acid-neutralizing ability, an acid sludge is to be expected. Great acid-neutralizing ability will guarantee good Emscher tank sludge having an alkaline reaction.

We have already pointed out the necessity of the right mixture of sludge and sewage to obtain a good sludge, in a report which we made in 1908, on our West End test plant with a modified Emscher tank, a so called Kremer-Imhoff tank. The agitator, mentioned in this report, was ready for operation in the summer of 1909. In the meantime, numerous troubles occurred, bad sludge, spitting and frothing and the formation of scum. The installation of the agitator and its daily use brought an alkaline and better sludge. We tried to overcome the frothing and the scum formation by a timely withdrawal of sludge, but in spite of this sometimes the whole contents of the sludge-digesting chamber threatened to boil over. After long consideration, it was decided to drain off the water in the sludge-digesting chamber. This was done in December, 1910. The sludge-digesting chamber was refilled from the top with clean water from the municipal water system and the sedimentation chamber refilled with sewage; the usual operation was then resumed. A week later we had for the first time a fully satisfactory typical Emscher tank sludge and it continued to be of the same good quality until the plant was discontinued during the summer of 1913. The operation of the sludge-digesting chamber, to which no more clean water was added, was as follows:

The agitator was run for a short time every day. On every Saturday, an exact predetermined amount of sludge was withdrawn from the sludge-digesting chamber. Care was taken that after the withdrawal of the sludge, the proportion of sludge and water in the sludge-digesting chamber remained in the ratio of 1 : 2. Frothing and the formation of injurious scum did not occur again.

The principal conditions which lead to the formation of good sludge are, in our opinion, quite clear. The proportion between water and sludge and between acid-neutralizing agents and sludge must be right; the mixing of the parts, by agitators, if necessary, must be thorough, if the plants are expected to ripen and the formation of acid sludge is to be avoided. Regular withdrawal of sludge, of proper amounts, will assure good operating results. The sludge-drying beds should be so arranged and partitioned that the sludge can be easily measured. The operation should include frequent tests as to the reaction of the sludge and the supernatant water. It should be taken into consideration that not only organic acids, but also carbon dioxide, mineral acids and sometimes acid salts, are able to cause an acid reaction.

(2) The Formation of a Scum and the So Called Frothing or Spitting of a Sludge-Digestion Tank

The causes and the detrimental influence of the following phenomena have to be judged differently, depending on whether the sludge considered is already ripe or still in the ripening period. The difficulties on account of the formation of a heavy scum cover are greatest in the latter case.

A skin of microörganisms and particles of fat are formed on an ordinary covered septic tank, rising sludge sticks to this, and the cover gradually increases in thickness. With purely domestic sewage only a floating cover is formed, with practically no layers in suspension. If storm water only is handled, suspended layers only are found.

Sludge in the digestion chamber of Emscher tanks and kindred installations is originally settled sludge from the sedimentation chamber. Sludge that forms the sludge cover obtained its floating properties only in the digestion chamber, a property due to its entrained gases of decomposition. The rising to the surface, and remaining there, of single sludge particles or whole sludge cakes, is doubtless dependent on the composition of the raw sludge in the sludge chamber and the intensity of the gas formation (proportional to the unit area of chamber). Fresh sludge will act differently than putrifying sludge, the latter causing less floating scum.

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*From Communications of the Royal National Institute for Water Hygiene in Berlin-Dahlen, Vol. 18, 1914, Art. 3. Here condensed from a translation made for the Sanitation Corporation, 50 Church St., New York City, which will publish the full paper as a pamphlet.

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The size of the deposited sludge particles also plays an important part in this matter. Disintegrated sludge particles, if not too fine, will gasify much quicker than coarse ones. It is important whether feces reach the sedimentation tank well broken up or in large pieces, as it is known that feces retain their floating ability for a long time, apparently because their compact structure offers a considerable resistance to the liberation of the inclosed gases. Finally, the manner in which the sludge particles settle, their sticking together through fat, hairs, etc., have great influence on the formation of sludge cakes, which to a great extent form the sludge cover. The influence of the intensity of the gas formation will be greater the deeper the sludge layer is. With a small free surface, where it can accumulate, the forming scum cover will be thicker. If the surface is too small for the scum, too many gas-laden particles will rise, so that the top layers cannot get rid of their gas quickly enough to sink.

A disadvantage of such a cover is that after it reaches a certain size the rising sludge cakes seek a way out through the open slots to the sedimentation chamber.

Different methods in practice have been tried to destroy and sink the scum covers, such as stirring it with poles or breaking it up with high-pressure water. None of these have been a permanent success, as they do not accomplish the necessary continued mixing of the newly rising sludge. This can only be done by the installation of a mechanical agitator or apparatus, which not only stirs the sludge, but also brings about a thorough mixture of the sludge with the sewage.

The sludge entering the sludge chamber should be well disintegrated. Any scum cover in formation should be broken up by a stream of sewage under high pressure, mechanical agitators, or lowering of the water level in the sedimentation chamber. The plant always ought to be so designed as to have a sufficiently large surface for the escape of the gases.

The appearance of frothing (spitting) in an unripe sludge-digesting chamber is a mere secondary phenomenon. It is similar to the so called "hut" formation in yeast fermentation, and is mostly caused by large amounts of gas rising to a small surface and carrying the sewage and finely divided sludge with it in the form of bubbles.

In ripe sludge-digesting chambers, the scum formation is much lighter and not liable to cause trouble, as the rising sludge is well mixed with sewage and the sludge at the surface loses its gas more readily than fresh sludge, not forming as much gas. But it must be removed from time to time. The spitting and frothing and entrance of sludge into the sedimentation chamber are generally caused by a too heavy floating layer or a too large accumulation of undissolved matter in the sludge-digestion chamber, in which case the gas will carry up froth if the free surface is too small. This can be helped by simply drawing off some of the sludge or permanently prevented by keeping the sludge at a permanent level.

(3) The Different Types of Fresh-Water Clarification Plants with Separate Sludge Digestion

Injurious formation of scum covers, frothing or spitting of the sludge-digesting chamber, acid sludge and, finally, acidulation of the supernatant water are the operating difficulties which are liable to appear in sludge-digesting plants if there is not sufficient room provided to accommodate the floating sludge, a too heavy formation of scum prevented and the sludge withdrawn at the right time.

The sludge-digesting plants under discussion can be divided into two groups. The first group includes those plants in which the sludge-digesting chamber is below the sedimentation chamber, and is connected to it by open slots, through which the sludge drops automatically. Under this head come the Emscher tanks, the Travis tanks, Kremer septic tanks (Kremer-Imhoff tanks), Stiag tanks, Spree tanks, Bus tanks, etc. To the second group belong those in which the sludge-digesting tank is a separate unit and is located beside the sedimentation chamber. The fresh sludge is periodically pumped or drained from the sedimentation tank to the sludge-digesting chamber.

Sludge-Digesting Chamber under Sedimentation Tank

These plants have the great advantage of an automatic sludge separation. But if the sludge is not removed at the right time, rising sludge will enter the sedimentation tank, which is a common occurrence in spite of the overlapping edges of the slots. Difficulty is found in giving the right dimensions to the sludge-digesting chamber in proportion to the sedimentation tank.

All installations coming under this group require expert supervision while ripening. To avoid acid sludge or a heavy sludge cover, which almost always gives an acid reaction, it is recommended to fill the digesting chamber only partly with sludge during the ripening period, and always to keep the sludge at the same level by periodically removing a like amount of sludge. As putrefactive decomposition can only take place while the sludge is alkaline, it has to be kept so at all times—if necessary, by the addition of chemicals. For protection against floating sludge covers, it is to be recommended from a technical point to make the free surface of the sludge-digesting chamber not too small. The partition walls between the sedimentation and digesting chambers should be so arranged that no sludge can collect under them and that the sludge carried up by the gases will be deflected either to the open surface at one side or the gas vents directly over the digestion chamber. The latter should be of sufficient size. Wide longitudinal openings, as are used on the Travis tank, seem to be the best. The long sludge chamber of these and similar plants should be divided into two parts, as in ordinary septic tanks: a larger chamber in which the sludge is digested, and a second smaller chamber in which the sludge particles carried up by the gases are separated. To obtain the largest possible surface and save construction costs, this Institute has sometimes recommended the use of earth ponds with large free surfaces as sludge-digesting chambers.

Separate Sludge-Digesting Chambers Beside the Sedimentation Tank

Under the head of separate sludge chambers, located beside the sedimentation tank, come the designs of Fœrster, Mondrion, the Neustadter sludge tank, etc. Opposed to the disadvantage of the cost of pumping is the not-to-be-lightly-valued advantage of the complete separation of the sedimentation tank from the sludge tank, so that the latter can never have any detrimental influence on the former. Besides the possibility of unlimited extension, separate sludge tanks have the further advantage that they are very accessible and easily inspected. The decomposi-

tion of the sludge can be followed in all its stages and can be governed as necessary or desirable. With high ground water, the first cost of the shallow tanks will be considerably less.

Separate sludge-digesting tanks can be built as single units which are intermittently filled (Fœrster), or as a series of tanks which make a continual operation possible (the Neustadter tank). A good sludge digestion is obtained by both types. The single units require individual expert operation, but the continual (daily) operation of tanks in series can be made almost entirely automatic. The first mentioned construction can be easily arranged so that the tanks can be operated either as units or in series. In arranging the tanks in series, the different processes can be separated. The brisk decomposition of the sludge and sewage will take place in the first tank, and in the last tank the sludge can be "washed" by the introduction of clean water before it is drawn off. The advantage of washing the sludge in no way interferes with the addition of the sewage, necessary for a brisk decomposition. Sewage should always be introduced into the first tank, if not enough is contained in the withdrawn fresh sludge. The following arrangement can be recommended: The clean water should be introduced into the tank that contains the best digested sludge, then passed from there to the tank that contains the second best sludge, etc., until it is let off, so that the sludge in a certain stage of digestion never comes into contact with sewage from a sludge in a less advanced state of decomposition. The capacity of such tanks ought to be about the same as those that proved sufficient for Emscher tanks.

RÉSUMÉ

Fresh-water clarification plants, with a separate sludge digestion, considered as a whole, are a distinct advance in the field of sewage and sludge treatment. They simplify the mechanical clarification of the sewage, lessen the sludge nuisance and have advanced the solution of the sludge question.

The obtaining of a good sludge did not prove to be such a simple matter as was originally supposed. Communities which have their plants built by contractors will do well not to accept the plants until the sludge-digestion chamber delivers a good sludge. Very careful preliminary investigation should be made in each case to find out whether such a process is suitable to local conditions. Due consideration should be given to the difficulties of construction and operation. Other points to which attention should be paid are: Whether the sludge-digesting chamber should be located below or beside the sedimentation tank, or whether both types should be used; also whether it would be best to install an agitator at once or only make provision for a future installation.

With expert design and expert supervision, it is possible to avoid the above discussed operating troubles, which often make an otherwise good plant unsatisfactory. It will be absolutely necessary to stop the now prevalent custom of building all plants after one pattern; also when considering the efficiency of a plant, a sharp line should be drawn between the two functions, sedimentation and sludge digestion.

Good Roads Construction in Colorado has made headway in the adoption of a constitutional amendment authorizing a half-mill tax levy to be used by the State Highway Department. This is expected to yield about half a million dollars yearly for state-aid highway work.

Repairing and Resurfacing Bituminous Pavements

By Samuel H. Lea*

A cheap but effective method of renewing the surface of old bituminous pavements was employed by the writer recently on some streets in Charlotte, N. C. In this city there is a considerable area of "bitulithic" pavement, laid in 1907-'08 under a 5-year guaranty by the contractor. Since the expiration of the guaranty period it has become necessary for the city to maintain this pavement.

Failure of Macadam Foundations—The area under consideration comprises some of the principal business streets in the heart of the city, where traffic is quite heavy. These streets were originally macadamized and, since the old macadam had been in place for many years, it was thought to be suitable for a base for the "bitulithic" pavement, which, accordingly, was laid directly upon it. This method of construction has not proved satisfactory, especially for streets with heavy traffic, and it has been discontinued. The city's specifications now require all pavement to be laid on a concrete base.

Repair Work

Soon after the expiration of the contractor's guaranty the pavement began to show signs of wear and, in many places, small holes appeared; these quickly enlarged by raveling, becoming in some cases sufficiently large to cause serious inconvenience to traffic.

Patching—The first repair work undertaken by the city was in January, 1914; this consisted in cutting out the raveled places and patching the holes with new material. The work was done by a contractor who was then engaged in paving other streets in the city with sheet asphalt, which material was used for making the patches in the "bitulithic" pavement. The patches thus made were strong and durable, joining up smoothly with the adjacent surfaces. The appearance of the finished work, however, is not uniform; the patches are rather conspicuous, especially after rains.

The work was confined to the repair of worn places and depressions in the pavement and no attempt was made to treat the adjacent surface of old pavement. In making the patches the edges of cuts were trimmed smooth and vertical and all loose material was removed from the holes, care being taken to cut into the old macadam foundation as little as possible. The edges and bottom of the cut were then painted with hot liquid asphalt, and the hole was filled with asphalt paving mixture, heated to a temperature of about 275° F. The edges of the patch were then smoothed with a hot iron, tamped by hand, and the patch compacted with a steam roller. The appearance of typical cuts, ready for filling, is shown in Fig. 1. The loose stones in the bottom are part of the old macadam base; this was carefully tamped by hand before the cut was filled with new material.

Cost Data—Since the repairs were made in the form of isolated patches, scattered over a wide area, no satisfactory unit price for the completed work could be agreed upon in advance, and it was decided to have the contractor perform the work at actual cost for labor and material plus 15% for use of tools and plant. The city provided an inspector who accompanied the repair gang from

*City Engineer, Charlotte, N. C.

place to place and supervised the work. After the completion of repairs the total cost was determined, also the extent of work. From these data the following statement has been compiled:

Total area of patches made: 308.6 sq.yd.	
Material and labor	$609.75
Cost of inspection	32.00
Total cost of repairs	$641.75
Unit cost of work: $2.08 per sq.yd.	

Repairs with Asphalt "Pancakes"—The foregoing repair work was completed in the latter part of January, and it was then thought that additional repairs to the pavement would not be necessary for a considerable while, since there were at that time no further signs of raveling. This condition did not continue long, however, for within a few weeks new holes began to appear and the surface of the pavement continued to deteriorate, assuming a deeply pitted appearance over practically the entire area. On College St., where the traffic is heavy trucking for wholesale houses, the pavement soon raveled badly and was

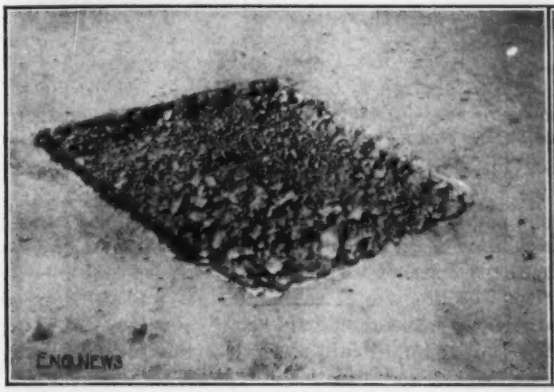


Fig. 1. Cuts in 7-Year Old "Bitulithic" Pavement on Old Macadam Foundation; Ready for Filling with Asphalt Mixture

worn into holes in many places. This condition is shown in Fig. 2, which is from a photograph of a portion of College St., taken in May, 1914.

In June, it was decided to make the additional repairs that were then necessary, and a repair gang was organized from the city street department. This gang included a foreman, four laborers, a driver with a one-horse wagon. The patching material was obtained from "pancakes" or slabs of ready-mixed sheet asphalt, which had been made up for this purpose during former paving operations in the city.* These "pancakes" had been stored under cover and were in good condition for use upon being heated to the proper temperature. The city's 10-ton steam roller was used for compacting the patches after the cuts were filled and the edges had been tamped down by hand and bonded to the adjacent pavement with a hot smoothing tool. It was found that the three-wheel roller, used under these conditions, did very good work, making a smooth and compact surface.

Cost Data—The total area patched in June was 422.14 sq.yd. as compared with 308.6 sq.yd. in the first work described. The regular tools and equipment of the city street department were used as far as practicable, and such additional equipment as was purchased for the work was charged to cost of work. The steam roller was charged at the rate of $10 per day for machine and roller man. The ready-mixed asphaltic paving material used was estimated as being worth 40c. per sq.yd. in finished patches. The following statement covers the cost of the work:

Total area of cuts filled: 422.14 sq.yd.	
Labor and tools	$294.18
Patching material	168.86
Total	$463.04
Unit cost for area repaired: $1.10 per sq.yd.	

*A more detailed account of this method of making repairs will appear in a subsequent issue.

Surface Treatment

Soon after the completion of repair work in June it was decided to apply a flush coat of cold refined tar to the entire pavements under discussion. The object was to fill up the small pits and depressions in the surface of the old pavement and also to renew or replace, as far as practicable, the cementing material or bitumen that had escaped from the body of the old pavement; and

Fig. 2. North College St., Showing Condition of a 7-Year Old "Bitulithic" Pavement on Old Macadam Foundation; before Patching

to prevent, for a while at least, further raveling or disintegration of the pavement.

Materials and Methods of Work—The pavement was first gone over with the city street-sweeping machines; usually on the night before repair work was commenced. Later, a suitable area was roped off from traffic and the surface was swept by hand immediately before applying the refined tar. The working force comprised a foreman, six laborers and a driver with a one-horse wagon. Sand was delivered at convenient places by contractors at a fixed unit price. The wagon was used to haul and distribute the other materials as needed. The refined tar was brought to the job in barrels; from these it was pumped into buckets and spread by hand over the pavement.

The tar was then swept along by laborers, using wire push brooms, and distributed so that every portion of the pavement surface was covered. The tar was sufficiently thin to penetrate readily into the pavement. A sufficient quantity of the tar was poured over the surface to allow the pavement to absorb it to saturation; the surplus tar found its way to the gutters, from whence it was later taken up for further use. The tar was forced into the pavement by the sweepers as much as possible, the object being to make it serve both as a filler and a seal coat for the pavement.

After application, the treated surface was allowed to remain unmolested for from one to three hours; it was then covered with coarse sand to a depth of about ¼ in. The street was then opened to traffic.

COST DATA—A careful account was kept of every item of expense entering into the work; from this the following statement of cost has been compiled:

Total area of pavement covered by surface treatment: 27,911.1 sq.yd.	
200 cu.yd. of sand at $1.06	$212.00
Labor, including team	240.68
Tools purchased for the job	20.00
3450 gal. of refined tar at 10½c.	362.25
Total	$834.93
Unit cost of work: 2.99c. per sq.yd.	

CONCLUSIONS

A comparison of unit costs for the two jobs of patching shows a much lower rate for the work done by the street department, using ready-mixed paving material. As a result of the experience herein described, it is probable that the city will adopt this method for future repair work. If bituminous paving material, prepared for use, can be obtained at a reasonable price, there is no necessity for a city to purchase and maintain an expensive asphalt plant for ordinary repair work; in such cases repairs can be cheaply and effectively made with a comparatively small outfit.

The surface treatment of the old pavement after the completion of repairs was in the nature of an experiment, it being the first work of the kind attempted in this city. Considering the low unit cost of the work, less than 3c. per sq.yd. of pavement covered, the results obtained are quite satisfactory.

In addition to the operation of flush coating, and while this was in progress, some shallow patches were made without cutting the old pavement. This was done by filling the depressions with finely crushed stone coated with the surfacing material and tamped with hand tampers until the patch was thoroughly compacted and bonded to the old pavement.

Experience has shown that more sand was used in the work than was necessary for the best results. The sand, after being spread, was allowed to remain in place for a week or more, and while a considerable portion was taken up by the tar, much of it was washed by rains into the gutters, from whence it was later removed by the street-cleaning department. About one-half the quantity of sand used would have been sufficient for the purpose.

The bituminous coating went much further and covered more area than was expected. One gallon of the refined tar covered a fraction over 8 sq.yd. even after being allowed to soak freely into the old pavement. The penetration was good as was shown by cutting into the pavement in several places after the tar application. It was found that the tar had, in most cases, penetrated as far as an inch or more below the surface.

A noticeable feature was the springy, elastic nature of the surface of the old pavement after treatment. This was a matter of general comment by citizens, many of whom had been skeptical about the work in its early stages. The raveling of the pavement was arrested for the time being by the treatment; it is not expected, however, that raveling or wear will be prevented for any great length of time. Such a consummation would be too much to expect from a superficial application of a cold bituminous material.

On the whole, the results obtained from this experimental work are considered quite satisfactory, and it is thought that the work done has been efficient and economical and well worth the cost.

A Snow-Removal Plan for New York City*

In past years the city depended upon trucks alone to haul snow from streets to waterfront dumps, the work starting as a rule after the storm was over and traffic retarded or completely blocked. No other method was considered available, and the speed of clearing snow from streets thus depended upon the supply of trucks for snow work. The maximum number of vehicles which could be procured last winter was 3000, and each truck averaged 50 cu.yd. per day. Under these conditions 150,000 cu.yd. of snow was the maximum amount per day that could be removed from roadways. With the 38-in. snowfall in February and March of this year, it required over 40 days to clear snow from the 1914 scheduled area of 20,000,000 sq.yd.

The only additional method of accelerating the removal of snow, up to last winter, was by decreasing the length of haul for trucks through the use of main trunk sewers for snow disposal, and only a limited number of such sewers was allowed in the Borough of Manhattan.

As a result of last winter's experience and tests it appears that the city has had available for years past a possible solution of the problem of rapid snow removal through the extensive use of sewers, not alone after a snowfall, but during the progress of the storm. It was also learned that snow work should be started with the storm, *clean* snow dumped into sewers as it falls, and the attempt made to keep pace with the storm, instead of trying to dig the city out after the block has occurred.

It should be recognized that these discoveries regarding snow work must be tested by a winter's experience, but whatever is done next winter in the disposal of snow through sewers must be considered as a decided addition to past months, which likewise will be continued in operation.

THE 1914-1915 SNOW-FIGHTING CAMPAIGN

Based upon the data concerning snowfalls, it is planned to utilize all sewers having a sufficient flow of water to transport snow and by means of regular sweepers acting as squad foremen, to assign emergency laborers in sufficient number to place in manholes snow falling at the rate of ½ in. per hr. The number of emergency men required for this purpose will approximate 15,000 per shift of eight hours.

In addition to pushing snow into sewer manholes on scheduled streets where sewers are available for snow disposal, the snow-fighting force will remove snow from intersections of paved non-scheduled streets, placing it in sewers where such can be used, or else piling it. It is also part of the plan to assign the snow-fighting force to clean the roadway at nearside street-car stops.

Last year's experience in disposing of 800,000 cu.yd.

*From a report by J. T. Fetherston, Commissioner of Street Cleaning, New York City, to the Board of Estimate and Apportionment on "Final Plans for Snow Work, Winter of 1914-15." The report was dated Nov. 10, 1914. It was submitted, in part, for the purpose of securing the approval by the board of certain elements of the plan. This approval has since been given. Some statements from the report were published in our issue of Nov. 26, 1914, p. 1095.

of snow in large sewers demonstrated the economy of this method, the cost being approximately 15c. per cu.yd. Special tests in the various boroughs, together with scientific observations conducted by the Sewer Bureau of the Borough of Manhattan,* verified the general conclusion that all sewers having a sufficient flow of water can be utilized for the disposal of *clean* snow without injury to the sewers. On streets where sewers are unable to carry off the snow, the roadway will be cleared and the snow piled for removal by carts or trucks.

For the purpose of showing the advantage of snow-fighting work over contract removal, a tentative estimate of the time required to clear the scheduled area in the three boroughs and the cost thereof is presented herewith.

Assume snow falling at the rate of ½ in. per hr., the storm continuing for 14 hours:

Item	Snow Fighting Force	Contract Work
Estimated time required to complete work after storm ceases	4 hours	168 hours
Estimated cost per million square yards cleared	$5,460	$22,438
Estimated total cost of clearing scheduled area	109,200	448,760

This estimate, as well as all plans for snow fighting, is based on the following assumptions:

(1) That a sufficient force of emergency labor can be started at work, day or night, within four hours after a continuing snowfall begins.

(2) That a rate of pay sufficient to attract labor and make the men anxious to work can be offered by the city.

(3) That the weather conditions will not be so extreme as to prevent men from working during the storm.

(4) That a sufficient amount of normal sewage is flowing in the bulk of the sewers to transport snow to the rivers and harbor.

(5) That the ordinary flow of sewage can be supplemented by water from hydrants where the normal flow is insufficient to transport the snow.

As the snow-fighting method involves a new departure in snow removal, every effort has been made to plan the work so as to meet anticipated conditions. This has involved a tremendous amount of detail study and observation of factors heretofore unknown.

To meet the various requirements of the snow-fighting problem, the following work has been completed.

1. Survey of Sewers—The depth of sewage and quantity of sediment in 50,000 sewer manholes and the velocity of sewage in 1098 miles of sewers, in the boroughs of Manhattan, the Bronx and Brooklyn, have been determined and the information plotted on maps.

2. Weather Conditions—Meteorological information regarding the duration, rate and fall, and depth of snowstorms has been studied and all published figures concerning snowfalls and their prediction by observation of the barometer, wet- and dry-bulb thermometer, direction and force of wind, cloud formation, etc., are available and will be used in conjunction with the weather reports from the United States Weather Bureau.

3. Labor Conditions—A general examination has been made of the available supply of labor and plans for quickly filling the quota required on snow fighting have been prepared. Registration of snow fighters at the various section houses and stables will be started about Nov. 15, 1914. All printing and forms for this purpose have been ordered.

4. Assignments—After the registration begins, notification cards will be sent to all men on the list, giving their assignments and information as to time for reporting and location of stations. Each individual or gang will have a set task to accomplish within a specified time.

5. "The Call to Work"—Should a snowstorm start during the day, the street-cleaning force will be available, and emergency laborers with notification cards will have instructions to report without special notice. If, however, a storm starts during the night, it will be necessary to call all men. It is proposed that the police shall coöperate with this Department, so that when notice is given by the Commissioner to Police Headquarters, all patrolmen will be reached by telephone as soon as possible and will call out the regular employees of the Department, as well as the emergency men. A list of all employees and registered laborers will be furnished for each patrolman's beat in the three boroughs, and in this way it should be possible to get a large number of men into service on short notice. In addition to the notification by the Police Force, the night workers in each Department stable will be utilized for calling men to work.

6. Equipment—The principal tool used on snow fighting will be the sweeper's pan scraper, supplemented by road scrapers, scoops, plows, picks, etc., all standard Department equipment. It is likewise proposed to increase the snow-carrying capacity of sewers by using bags as temporary dams where necessary to increase the depth of water in the manholes.

7. Unscheduled Streets—On streets where removal is not deemed essential, snow plows attached to automobiles and horse-drawn plows will be used for opening roadways for traffic. Street intersections with near-side cars will be cleared while the storm is in progress.

Organization and Management of the Snow-Fighting Force

Organization—Three divisions will be organized for snow fighting: (1) The first line of attack will comprise regular Department employees, supplemented by emergency laborers. The unit of organization will be based upon the sweeper as leader of a squad of emergency laborers, working under the direction of regular department officers.

(2) The first reserve will consist of regular drivers with horses and carts, drafted for a night shift, to clear streets where the snow-fighting force cannot use the sewers.

(3) The second reserve will consist of private trucks for day and night service, used as a supplementary force when the two regular forces have been unable to cope with the storm. This reserve force will be covered by the registration of private vehicles and assigned as may be necessary according to the requirements of the situation.

Management—Definite printed instructions have been drafted to cover all phases of the work, and classes have been started for the officers of the Department. Drills of regular employees will be held after Nov. 15, and night or day calls will be tried to prove their effectiveness.

*See article in "Engineering News," Oct. 29, 1914.—Editor.

Hell Gate Arch Bridge Not a New Thing—The following is a curious allusion to the 977½-ft. steel arch which the New York Connecting R.R. is now building across Hell Gate, East River, New York:

> Never perhaps since our first Bridge-Builders, Sin and Death, built that stupendous Arch from Hell-gate to the Earth, did any Pontifex, or Pontiff, undertake such a task.

It is taken from Carlyle's "Sartor Resartus," Book I, Chapter XI. The "pontifex" of the present Hell Gate arch is Gustav Lindenthal.

Field and Office

Portable Hoist Towers for Concreting*

Portable hoist towers for conveying and placing concrete are gaining in favor with contractors. Very often it is cheaper to employ a movable tower than to erect a high stationary structure.

An interesting application of this method on retaining-wall construction is described below. A second case is given where the mixer and the tower are both portable, mounted on standard flat-cars, and moved about a large area, with excellent results.

Stationary Mixer and Moving Hoist Tower

A hoist tower mounted on trucks is used to convey concrete from mixer to construction in the four-tracking work of the New York Central & Hudson River R.R., now under way at Poughkeepsie, N. Y. This work includes the building of several retaining-walls, one of which is shown in the making, with the portable tower at work, in the accompanying views, Figs. 1 and 2.

The wall is of the standard gravity type. It is about 23 ft. high at the northern end, 10 ft. wide at the base, and 21 in. at the top with a 2-ft. coping. The lower end is 6 ft. high, with other dimensions corresponding.

In building the lower portion of the wall wheelbarrows were used instead of the tower. By this method 20 men placed 40 cu.yd. of concrete per day. After 13 days a movable hoist tower was brought on the job from a wall near-by which had been built with the tower, and the 20 men then handled 125 cu.yd. daily.

This portable hoist tower is mounted on four wheels, which run along at the base of the wall on a standard-gage track. The tower is 34 ft. high and is equipped with a ½-cu.yd. bucket which can be tipped at any elevation desired. The general layout of the work is shown in Fig. 2.

Fig. 3 shows the rigging of the tower. A cable runs from a drum of the two-drum hoisting engine to a pulley on the car, thence over two pulleys at the top of the structure, down to a pulley on the bucket and up to a fixed point on the top of the tower. The car is moved forward by means of a cable from the second drum to a deadman at the farther end of the track and back to the front of the car, as shown in the diagram. To return the tower to the mixer, the bucket is blocked and the hoisting drum of the engine operated.

A depression in the track at the mixer allows the bucket to be lowered below the level of the chute from the

*The following articles on hoist towers have appeared in "Engineering News" of recent date: "Steel Concreting Tower Designed for Rapid Erection," Sept. 24, 1914, p. 649; "Portable Concreting Plant with Telescopic Tower," Nov. 12, p. 984; "A Sectional Telescopic Hoist Tower," Nov. 12, p. 985.

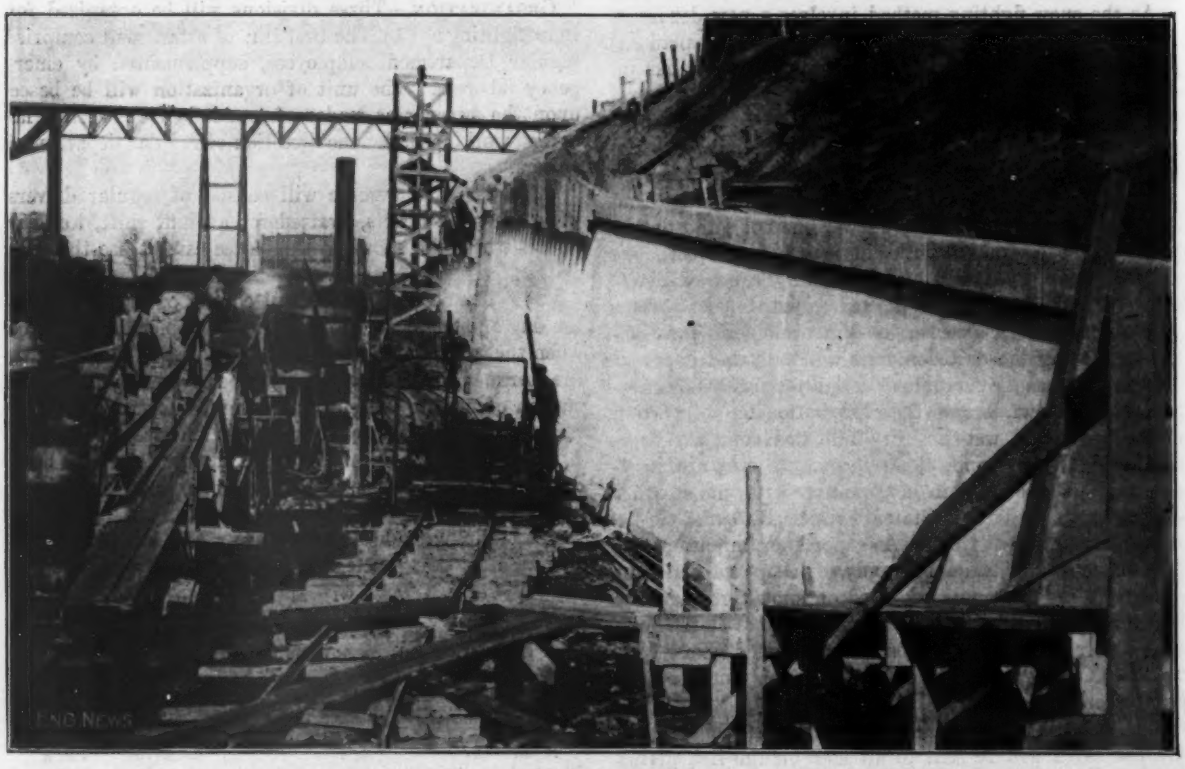


Fig. 1. General View of Retaining-Wall Work Opposite Poughkeepsie Station

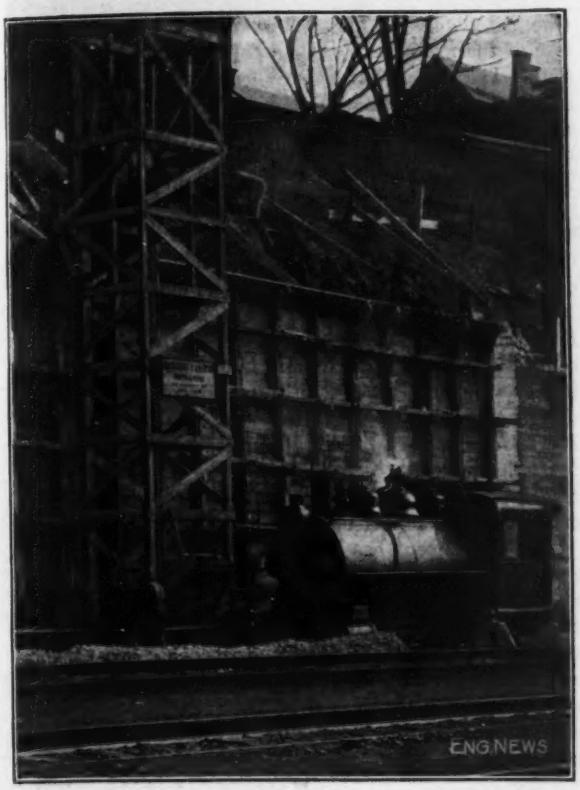


FIG. 2. PORTABLE TOWER AT POUGHKEEPSIE, BUCKET IN DUMPING POSITION

mixer, so that the concrete may be discharged into the bucket by gravity.

The work is being done for the New York Central & Hudson River R.R., under the direction of G. W. Kittredge, Chief Engineer; J. W. Pfau, Engineer of Construction; R. E. Dougherty, District Engineer, Eastern District, by Richard & Gaston, contractors, New York City (W. McKee, Superintendent on the job).

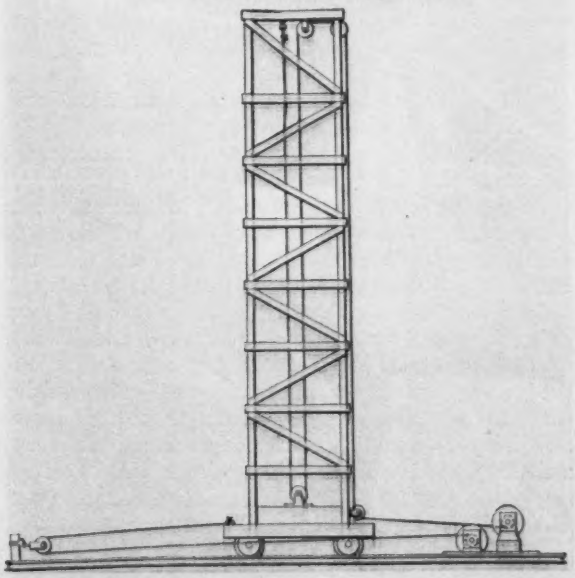


FIG. 3. RIGGING OF POUGHKEEPSIE CONCRETING TOWER

MIXER AND HOIST TOWER ON FLAT-CARS

At the Jersey City terminal of the Central R.R. of New Jersey, a portable mixing and distributing plant was desirable on account of the large area over which the work was distributed, the small amount of concrete placed in any one location and the difficult conditions imposed by sustained traffic. The work of handling materials, mixing and hoisting to roof were all done on two existing standard-gage tracks, 13 ft. c. to c., immediately adjacent to the work. The concreting materials were brought in on cars directly to the ¾-cu.yd. mixer mounted on a standard 40-ft. flat-car and which was fitted with permanent runs, water-tight cement bins, and water connections.

After mixing, the concrete was dumped directly into the hoist bucket which was permanently located with tower and hoisting engine on a standard 50-ft. flat-car, with permanent sway braces, guides, etc. The tower was 82 ft. high, and near the top was equipped with an ordinary receiving hopper, which discharged into three Insley steel chutes, 30, 20 and 15 ft. long.

The chutes were supported at their hopper joints by rigging hung from two booms, 30 ft. and 32 ft. in length, respectively, which were attached to the side of the tower, well up toward the top. The whole rigging was supported from the tower, with the exception of the discharging end, which was moved from place to place by two men. The booms were free to swing in any direction, and the plant discharged over a semicircular area having a radius of about 50 ft.

FIG. 4. CONCRETING TRAINSHED, JERSEY CENTRAL TERMINAL, WITH HOIST TOWER ON FLAT CAR

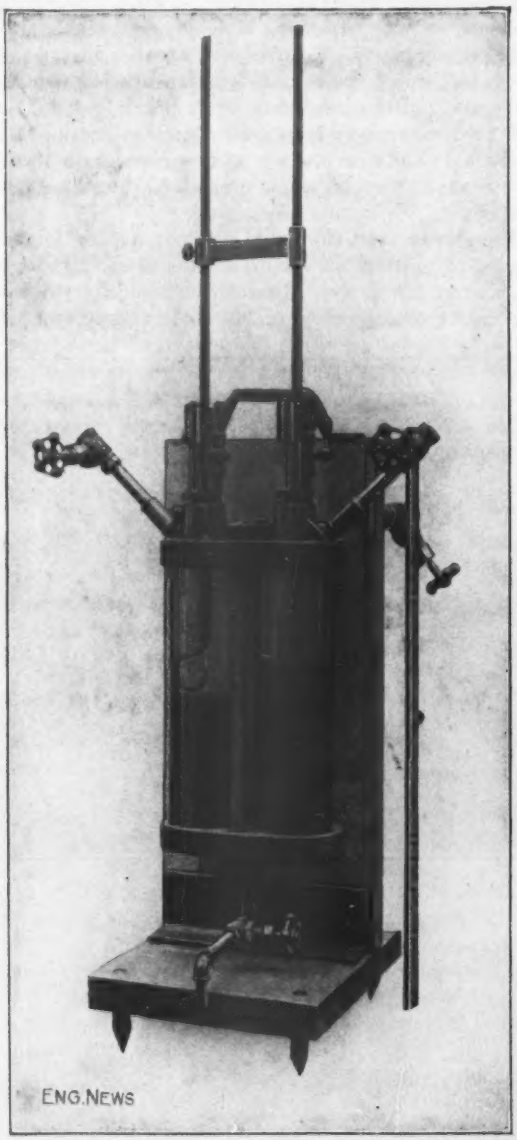
This mobile mixing plant allowed the concreting to proceed very rapidly; in fact, practically as a continuous operation. The plant was often moved 100 ft. or more during the noon half-hour. With this plant from 60 to 90 cu.yd. of concrete were placed in 3½-in. roof slabs, which were cut up with numerous skylight curbs, smoke ducts, etc., by about 30 men in an 8-hr. shift.

The work was done by R. P. and J. H. Staats, New York, under the direction of Joseph O. Osgood, Chief Engineer of the New Jersey Central; A. E. Owen, Principal Assistant Engineer. C. M. Titsworth was Assistant Engineer in Charge of Construction, for the railroad

A Differential Gage for Very Small Pressure Differences

By William Easby, Jr.*

A novel form of differential gage, capable of accurately measuring very small differences of pressure, is shown in the accompanying illustration. It differs in two respects from the usual forms in which a gage liquid heavier than water is used. First, the tubes are so large in diameter that the troublesome irregularity of the meniscus so common in the usual sizes of tube is confined entirely to



A Differential Pressure Gage for Measuring Small Pressure Differences

the edge, leaving a large plane surface unaffected by capillarity. The second point of difference is in the employment of special hook-gages to measure the deflection. The hook end was originally provided with the customary sharp point, but is now finished to a small convex surface (more easily seen) which can be accurately set in the surface of the meniscus by bringing it tangent to its reflection. These hook-gages have a common vernier reading to 0.001 ft., attached by an arm to one of them and surrounding the graduated rod of the other. To set the vernier, the tubes are subjected to the same pressure. The ends of the hooks are then brought tangent to the meniscuses and the arm is moved until the zeros of the scale and of the vernier coincide. Colored carbon tetrachloride, to which benzine has been added to obtain the desired density, is used for the gage liquid.

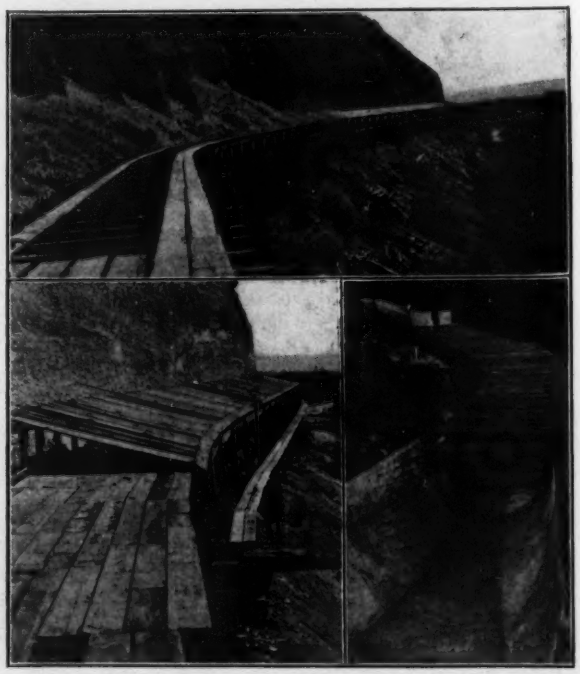
It is essential for accuracy, particularly when the deflections are but a few thousandths, to rid the gage and connections of all air, which is most easily accomplished if they are placed lower than the source of pressure. Caution should also be used respecting the effect of heat. It was found that a lighted incandescent lamp held for a few minutes close to one side of the gage caused sufficient expansion of the carbon tetrachloride in the tube on that side to render observations almost worthless.

This instrument has been used successfully in the hydraulic laboratory of the Civil Engineering Department of the University of Pennsylvania, to investigate the distribution of velocities of approach in weir tanks, to study the critical velocities in pipes and for other experimental work. It can be adapted to a considerable range of pressure by varying the density of the gage liquid, but it is of greatest service in measuring very small differences of pressure.

*Professor of Municipal Engineering, University of Pennsylvania, Philadelphia.

Irrigation Flumes of Ingot Iron

Flumes made of ingot iron are being used on a number of irrigation projects in the Western states. The Cascade Irrigation District, Ellensburg, Wash., will have 25,000 lin.ft. of metal flume, which is said to be the longest large flume of this kind in the United States; 7000 ft. of this were installed in 1913 and 9000 ft. (of No. 16



Irrigation Flumes Built of Ingot-Iron Plates

gage) in 1914. This district will have also four concrete-lined tunnels aggregating 1¼ miles, ¾ mile of concrete-lined canal, and 30 miles of earth canal. This district has an area of 13,000 acres, to be supplied with water from the Yakima River, and the work is provided for by a bond issue of $700,000. R. W. Rea is chief engineer; D. C. Henny, U. S. Reclamation Service, is consulting engineer.

The Tumalo Irrigation District, of Laidlaw, Ore., has an area of 22,000 acres under irrigation from the Deschutes River, and about 9000 ft. of metal flume have been installed. About $450,000 of state funds have been expended on this project during the past two years. O. Laurgaard is project engineer.

The metal flumes on the above works are of the Lennon type, made with semicircular sheets of the Armco ingot iron, and supplied by the Coast Culvert & Flume Co., of Portland, Ore., to which we are indebted for photographs and information. In the accompanying cut the upper view shows a long stretch of hillside flume. The portion built against the bluff has an inclined roof to throw off any débris falling upon it. This roof is shown more distinctly in the lower left-hand view. The lower right-hand view shows the connection of a concrete feed canal with an iron flume.

⌘

High-Head Centrifugal Pumps may be installed shortly in the Aspinwall pumping station of the Pittsburgh (Penn.) water-works. This station is one of two handling the filtered water from the city's filtration plant at Aspinwall, 5 mi. above the city. It pumps against 280 ft. head into the new Cabbage Hill reservoir, North Side, but will later handle part of the pumpage into the Highland reservoirs, the upper one of which gives a head of 375 ft. now handled by the Brilliant pumping station, on the opposite bank of the Allegheny. A two-stage centrifugal pump driven by a steam turbine is contemplated.

⌘

Outline of Data to Be Obtained for a Report on the Feasibility of Any Irrigation Project

By H. F. Robinson*

In preparing data for a report or in the consideration of a proposed irrigation project, either nonstorage or storage, even the most experienced engineer often inadvertently omits the discussion of some item that has a vital bearing on the success or failure of the project, or fails to look up in the field something that necessitates another trip or the omission of important matter. It was to put into suggestive form, especially for the engineer in the field, the principal things to be observed and investigated, and as a list of topics that might be followed in making up the report, that the following outline was arranged. Since it was first compiled, ten years or more ago, it has been tried out in the field and amended from time to time, as experience directed, until it is thought that most topics that may be needed have been included.

Copies of the list or outline have been made and supplied to the engineers of the U. S. Indian Irrigation Service and others, and it has proven of value in their work. It is now offered to other engineers in the hope that it may assist them in similar work:

*Superintendent of Irrigation, in charge of all irrigation work for the Indian Service in Northern Arizona, New Mexico and Colorado; Albuquerque, N. M.

Outline of Required Data

NONSTORAGE SYSTEM

Physical features in general.
Altitude and climatic conditions.
Area that may be irrigated.
Nature of the land.
  Rough or smooth.
  Cost of clearing.
  Cost of leveling.
  Natural growths.
  Value of natural growths.
Ownership of land.
Source of water-supply.
  Quantity of water available.
  Flow of stream by gaging.
  Records of flow.
  Rainfall.
  Drainage area, its character and probable runoff.
  Prior rights involved.
  Is water adjudicated?
Quantity of water for this project.
Local laws and litigation.
Duty of water.
  Nature of crops.
  Length of irrigation season.
  Soil.
  Alkali.
  Seepage and evaporation.
  Amount of water needed for the land, or how much land may be covered with the water available.
  Methods of using water.
  Crop requirements.
  Rotation.
  Proposed methods of distribution.
Diversion works.
  Physical conditions at the proposed heads.
Dam.
  Kind.
  Cost of materials.
  Where obtained.
  Nearness and kind of rock.
  Other material that may be used, as timber for cribs, lumber that may be cut, sand, gravel, etc.
Carriers of freight.
  Distance from railroad.
  Cost of freighting.
Roads.
  Existing, required and changes necessary.
Headgates, waste gates, etc.
  Size and kind.
  Gate lifts.
Canal.
  Size, length, slopes, grades.
  Nature of material excavated.
  How excavated; teams, dredge or other methods.
  Labor; kind, availability, cost.
  Special or unusual structures.
  Automatic spillways, flumes, culverts, sand traps, bridges, etc.
  Laterals and structures.
Silt.
  At normal flow.
  During floods.
  Nature of.
  Drifting sand in water.
Possibility of increasing water-supply.
  Return water from seepage.
  Reservoirs.
  Pumping underground water.
  Cost of fuel.
  Depth to ground water.
  Other data relative to pumping.
Possibility of water power.
  Its value and market.
Products.
  Kind and market.
Condemnation and damages.
Rights-of-way.
Total cost of project.
  Cost per acre of ground covered.
Basis of return on investment.
Method and period of repayment.
Sinking fund. Interest.
Maintenance.
Very brief comparison with other similar projects.

STORAGE SYSTEM

Physical features in general.
Altitude and climatic conditions.
Drainage area.
Streams and tributaries.
Flow by gaging.
Records of flow.
Rainfall.
Probable runoff of drainage area.
Vegetation in storage basin.
Timber and fuel adjacent to basin.
Prior rights to any of the flow.
Water adjudicated or not?
Amount for storage.
Silt and sediment.
Alkali and salt.
Reservoirs.
  (A failure of any of the seven following requirements ruins the project.)
  1—Sufficient supply.
  2—Good basin.
  3—Good dam site.
  4—Good material.
  5—Good foundation.
  6—Sufficient good land.
  7—Sound commercial basis.
Dam.
  Kind proposed.
  Nature and cost of material.
  Where obtained.
  Carrier and freight.
  Nearness of rock supply, nature and quality.
  Sand and gravel.
  Other building material.
Temporary diversion of stream.
Permanent outlet of reservoir.
Spillway.
Amount of storage at varying dam heights.
Physical and chemical tests in general.
Power canals.
  Horsepower available.
  Power plants.
  Transmission.
  Use to be made of power.
  Value of developed power.
Maintenance.
Roads.
  Existing, now required, changes.
Underground water-supply in irrigated district.
  Analyses of underground water.
  Depth to water table.
  Probable quantity for pumping.
  Pumps and pumping.
Cost.
  Present and probable future cost.
Existing appropriations of water and rights.
Existing and proposed methods of distribution.
  (Cf. memo. under nonstorage supply.)
Local laws and litigation.
  Water rights.
    Existing and proposed.
    Attached to land?
Methods of using water.
  Duty of water in locality.
  Length of irrigation season.
  Crop requirements.
  Rotation.
  Seepage and evaporation.
  Losses in distribution.
  Return flow from irrigated areas.
  Depth to water table.
Soils.
Products.
  Markets.
Rights-of-way.
  Condemnation and damage.
Total costs.
  Cost per acre-foot of water stored.
  Cost per acre-foot of water supplied.
Cost of pumping.
  Area of land supplied.
  Cost per acre watered.
  Cost per acre-foot per foot of lift.
Basis of returns on investment.
Methods and periods of repayment.
Sinking fund. Interest.
Maintenance.
Relations of the users of water to the government, including contract for water (in case the project is a government project).
Very brief comparison with other similar projects.

Small Caterpillar Tractors for Miscellaneous Hauling

The accompanying illustrations show a type of gasoline tractor which is gaining favor in the Far West for a variety of hauling purposes. While not very rapid (about 4 mi. per hr.) these tractors are efficient and economical for hauling over roads and across country where no other kind of motive power, except perhaps several teams of

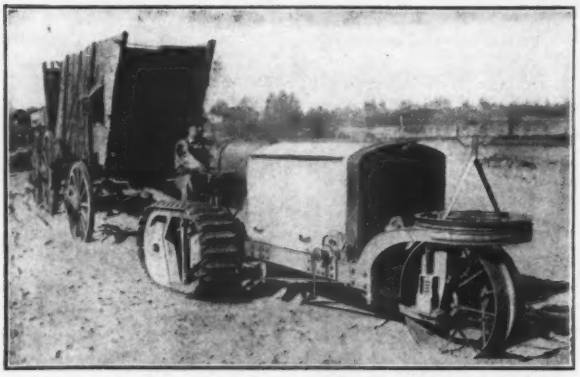


FIG. 1. SMALL CATERPILLAR GASOLINE-ENGINE DRIVEN TRACTOR USED IN THE WEST

oxen, could make any headway. They are used for drawing cultivating and other agricultural implements, for lumbering, freighting, and have proved of special value in engineering construction work.

For road building they are used to haul scarifiers, plows, scrapers, and grading machines, as well as material wagons. As stationary power plants they can be used for pumping, running concrete mixers, etc. For irrigation, ditching and levee building their ability to get over rough ground and soft, like new embankments, is a great advantage. They will climb up a levee slope or ride down into an irrigation ditch without the least difficulty. The tiller wheel operates on the same principle as the ball-bearing caster of a piece of furniture, and will turn the tractor around almost within its own length.

To protect the engine from shocks the axle bushing works up and down in the forks of the tiller wheel, on each side, against a powerful spring, which carries the weight of the forward end, and the track frames are supported near the center by heavy compression springs, engaging in brackets secured to the main frame. The particular feature of the tractors illustrated is a ball-bearing tread. All the weight borne by the treads is carried on a double row of large balls of chilled cast iron between each tread and its frame. The track links are of manganese steel. Two sizes of these tractors are made with pulls of 12 and 18 hp., respectively, and of 20 and 25 hp. as stationary power units. These tractors are made by Yuba Construction Co., of Marysville, Calif.

Some of the History of Steel Tapes

A correspondent has asked, "When were steel tapes introduced into surveying work?" This question is not so easily answered as it looks. Letters addressed to the leading instrument manufacturers brought indefinite replies in all except two or three instances.

Theodore Huse, Vice-President and Treasurer of the Lufkin Rule Co., wrote:

> We have no definite or authentic information on this subject, except that the first steel tapes were made in England and the first ones in the United States by the George M. Eddy Co., Brooklyn, N. Y.

The George M. Eddy Co. informs us that steel tapes were introduced in this country by Col. W. H. Paine about 1870. The use of a home-made steel tape during the same year is described by L. A. Nichols, President of the Chicago Steel Tape Co., in the following answer to our query:

> Steel tapes have been used for surveying purposes for probably 100 years. At first these tapes may have been of a nature to make questionable their title of steel tapes; they were measures on more or less narrow, thin pieces of iron, and were used where particular care was required in certain measurements, and preceded the advent of what is known as Gunter's chain.
>
> So far as the writer's knowledge goes, a real steel tape, that is, a tape made of steel instead of iron, and of a length which made it really a tape, and graduated at different points, was in use in America prior to the Civil War. It may have been in use for certain purposes a number of years before that date. By the writer's personal knowledge, the first use of a tape in this country occurred in 1870, when some hoopskirt wire was marked off for measuring bridge spans.
>
> The graduation or marking at first was merely scratched on the steel. As this became easily obliterated, the engineer in charge had solder run on the two ends, and marks made on this solder. Shortly afterward, and within the year 1870, an engineer, a Mr. Wheeler, of Worcester, Mass., obtained some of the hoopskirt steel rolled at the Washburn-Moen Mills in Worcester, put on a drop of solder at each foot and marked the graduations on this solder, the tape being 100 ft. long.
>
> The experience with this tape was so satisfactory that Mr. Wheeler had several made, and the writer, who was in Mr. Wheeler's party at the time and succeeded him shortly afterward, followed his example and made several more tapes, in a crude way, marking the graduations on solder run on the steel.
>
> These, so far as the writer's knowledge goes, were the

FIG. 2. CATERPILLAR TRACTOR HAULING A LOAD OF 7 TONS OF DREDGE BUCKETS UP A 16% GRADE

first steel tapes ever made with graduations marked on solder or babbitt metal run on the steel. Since then the writer has used these tapes generally, in preference to chains, in his work; and from comments received from other engineers he felt convinced that it was a worthy article of commerce, and in 1900 advertised to make this kind of tape, although as early as the '80s he had made several extra onces and sold them to associates. In 1900 the name, "Chicago steel tape," was adopted for that kind of a tape.

Prior to this, however, if the word steel could be considered in the light of any preparation of iron or bronze, the writer believes he has read in a translation of some foreign work, that a standard of measure made of metal was used in the construction of the Roman aqueducts.

Our own research shows that the first English patent for the manufacture of surveyors' tapes was granted in 1842 to James Chesterman and John Bottom, of Sheffield, County of York. This was for a tape partly or wholly formed of metal. The patent specifications read:

This may be done by means of thin plates of metal or woven metallic fabrics, or by the introduction of fine wires or an open woven metallic fabric in the manufacture of the tape. We prefer, however, introducing fine wires of silver or copper.

This is interesting because it proves that the manufacture and introduction of the well known metallic tape were coincident with the tape made of Sheffield steel. Subsequently, in 1847, James Chesterman was granted a second patent which fully covered the manufacture of steel tapes.

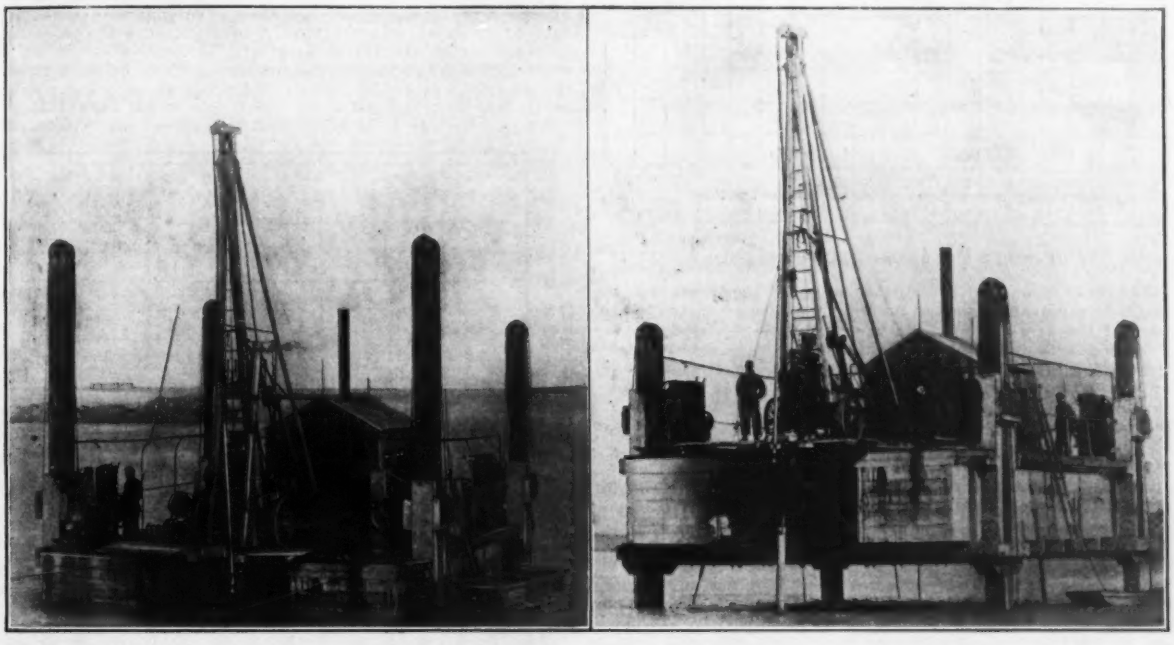
At first these were made of ribbons of steel joined together, and some were plated with copper or tin with engraved graduations. Later it was possible to roll the entire length in one ribbon.

The second patent also covered the machinery for making metal ribbon and metallic tapes, so that for many years Chesterman had a monopoly of the business in Great Britain. For many years, also, Chesterman tapes were used throughout the world. The firm still exists and is still turning out tapes, with which most surveyors are familiar, by name at least.

The only American patent granted previous to 1870 for a metal ribbon tape was in 1860, for a combination of a metal tape and a scale or gage for indicating or setting off the expansion. The tape was defined as a "jointless metal strip." This shows that the tape itself was neither new nor novel in America in 1860.

A Drill Boat Which Lifts Itself Clear of the Water

In the harbor of Port Weller, the Ontario entrance of the new Welland Ship Canal, there is now in operation a drill or sounding scow which has the unique ability of lifting itself clear of the water on its own spuds. The two views herewith show the method of operation of the scow. It is about 40 ft. square, of catamaran type, carrying a deck on which is an engine and upon which may be placed an ordinary field drilling machine, such as the one shown in the views. The scow was built for the general purposes of the survey staff of the new canal in connection with the harbor work, but principally to ascertain the elevation of the surface of the rock beneath the overlying material. As it was liable to be caught in rough weather, particularly as the harbor is a new one being built between breakwaters on an exposed shore, a steady platform was required. The engineer in charge first considered using one of the walking stages which were described in ENGINEERING NEWS, Nov. 2, 1911, p. 523, but the present design was found more practicable and cheaper.

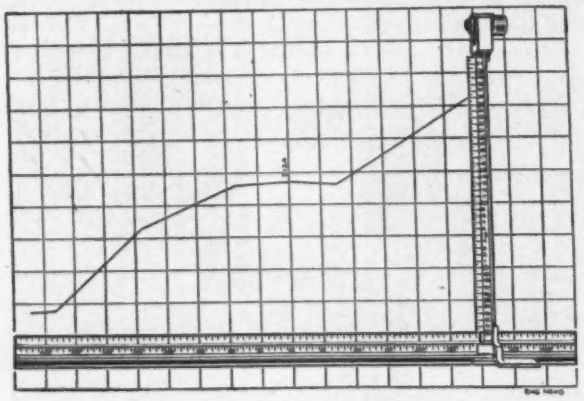


DRILL BOAT WHICH LIFTS ITSELF CLEAR OF THE WATER

The scow is framed to slide at each corner through a very heavy spud which carries two sheaves at its top. Over these sheaves passes wire cable from the outer part of the scow to individual engines, one just inboard of each spud. Normally the scow floats as shown in the left view, or is held at anchor in the normal fashion of dredges, but when a more rigid platform is required or when storms approach, the engines are individually started and the scow is lifted up to the position shown in the right view. The engineer in charge of the Welland Canal and responsible for the construction of the scow is J. L. Weller.

NOTES

A New Plotting Scale—The accompanying sketch illustrates a plotting device recently invented by Edward A. Zorsch, Winton Road N., Rochester, N. Y. The horizontal arm has a groove, a scale and a beveled straight-edge, also graduated. The vertical arm, perpendicular to the other, has a beveled straight-edge with blank graduations; and adjacent to this straight-edge there is a movable tape with corresponding

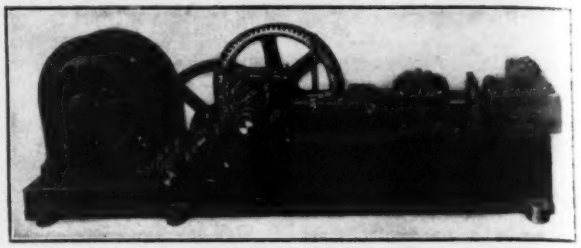


PLOTTING SCALE FOR CROSS-SECTIONS AND PROFILES

graduations, looped over the lower end of the straight-edge and over a movable spool at the top. A projector on the lower part of the arm fits into the groove on the horizontal arm. The device is intended for plotting profiles and cross-sections. The horizontal arm is placed with its straight-edge on the datum line and the tape on the vertical arm is adjusted to this datum line, so that the elevation of the point may be read directly on the arm scale. By use of the horizontal and vertical scales simultaneously, profiles may be plotted rapidly on plain, unruled paper.

A New Pipe-Joint Compound for use on pipe threads in making up screw joints, which is claimed to have material advantages over red lead and other pipe-joint compounds in common use, has recently been put on the market and is being extensively used in a wide variety of piping work. The material has the advantage over red lead that it remains permanently soft and plastic so that the joint can be broken at any time and made up again without difficulty. It does not give trouble by collecting on valve seats, etc., in a piping system, as red lead is apt to do. On the other hand, it appears to retain its viscidity on exposure to heat, so that it will withstand combined high pressure and temperature without leaks developing in the joint. It is being used successfully on pipe joints to withstand a hydraulic pressure of several thousand pounds per square inch and by New York City subway contractors on temporary street piping for gas and water where the pipes are placed in the street exposed to the shock and jar of wagons passing over them, so that joints made up in the ordinary way are apt to give trouble by leaking. The compound, which is known as "Deegan's Thread-Joint Seal," is put on the market by Chard & Howe, 250 Front St., New York City.

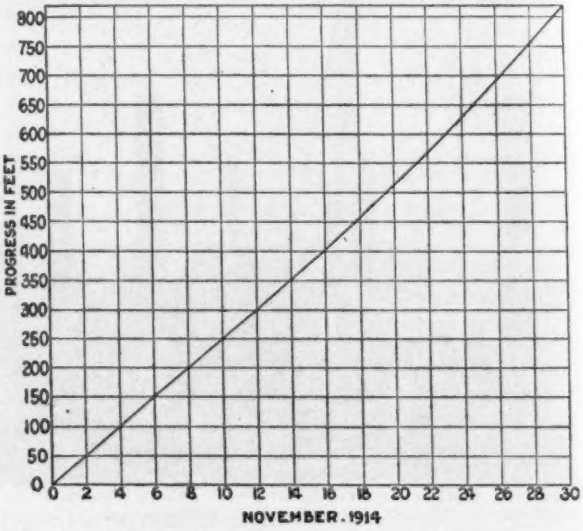
A High-Pressure Plunger Pump for Tunnel Service—A new design of triplex plunger hydraulic pump, for the high-pressure service of tunnel-shield driving, has been made by the Watson-Stillman Co., of Aldene, N. J. Pumps for such service commonly have been placed on the surface and the pressure transmitted to the work by pipe. This design, shown in the accompanying illustration, was made to fit the restricted working space of the erector platform. For compactness, rigidity and maintenance of alignment of parts, a single heavy cast-iron base is used. Shafts and bearings are large and fitted with lubricating cups. The motor is a 10-hp. size, running at 600 r.p.m. Two sets of heavy cut reduction gears bring the main-shaft speed down to 100 r.p.m. The plungers are driven from eccentrics set 120° apart, but cast in one block and held on the shaft by a single key. The straps are extra heavy. The tool-steel plungers move in a heavy cross-head guide which is both keyed and bolted to the base. The pump body is a machined steel forging; plungers are gland packed. Bronze poppet valves work in bronze bonnets, the passageway being kept as large as practicable to reduce



A HORIZONTAL HIGH-PRESSURE PUMP FOR TUNNELS

friction. The machine shown has a capacity of 100 cu.in. per min. at 3500 lb. pressure, and is 7 ft. 6 in. long, 3 ft. wide and 2 ft. 10 in. high. Other sizes are built.

American Record of Rock-Tunnel Progress—The daily footage made in November, 1914, at the pioneer heading on the Rogers Pass tunnel, of the Canadian-Pacific Ry., is shown by the accompanying curve. The curve indicates that the rate of progress was practically constant (the lowest daily footage was 21, and the greatest 37). A total of 817 ft. were made—an average of 27.8 ft. per day. This is believed to be the American record of rock-tunnel progress, previously held by Mackenzie Mann & Co., on the Mount Royal tunnel, Montreal, Que. (810 ft. in 31 days, 8x12-ft. heading; see "Engineering News," July 10, 1913, p. 66). The record week's work made on the Rogers Pass heading was 220 ft. The size of the heading is 7½x10 ft. On Nov. 30 the farther end of the heading was 3102 ft. from the portals. Three Leyner water drilling machines were worked on a 9½-ft. bar by a gang consisting of three drill runners, two drill helpers, eight muckers, one trackman, one pumpman, and one walking foreman for two headings. Haulage was by mules. The pioneer heading was driven on a 1% grade through rock. These figures were given by Joseph Fowler, Assistant Superintendent, pioneer heading, for Foley Bros., Welch & Stewart, contractors; A. C. Dennis, Superintendent. Progress on all headings for November was noted in our issue of Dec. 10, 1914, p. 1190.



CURVE SHOWING CONSTANT PROGRESS AT THE PIONEER HEADING, ROGERS PASS TUNNEL

A Standard System of Accounting for the Railways of China has been worked out by a commission headed by Dr. Henry C. Adams, Statistician to the Interstate Commerce Commission. Dr. Adams was given a year's leave of absence by the Commission to undertake this work for China. The first work accomplished by the Chinese Commission was the control of construction accounting. Rules for this have been promulgated and are now in force. According to Dr. Adams, accounting on construction work will hereafter be more systematic in China than in any other country of the world. By thus adopting a uniform system of accounting at the very beginning of the construction of its railway system, China has achieved something which other countries have not been able to accomplish until their railway systems were fully established.

Editorials

The Lavis Subway Articles

In this issue is concluded Mr. Lavis' notable series of articles describing the extensions of the New York subway system—the greatest engineering work now in progress in the world. We feel sure that many of the readers who have followed these pages for the past twelve weeks will be interested to know that the series is to be republished in book form, where it will be more readily available for reference than in the pages of ENGINEERING NEWS. The work which it describes is only about half done, but practically all of the design and the more difficult elements of construction are of the past, so the present text is adequate as a complete exposition of the subject. One further item—the design and construction of the steel elevated structures—will be taken up in a separate article in ENGINEERING NEWS at an early date.

British Sewage-Works Standards

Hard-and-fast standards for the effluent from sewage-treatment works have been the desire and aim of a certain class of sanitary reformers since sewage treatment began. Two years ago, the British Royal Commission on Sewage Disposal, in its Eighth Report, recommended a general standard with variations up or down, according to local conditions. This was a marked advance, but in the opinion of a committee of well known sewage-works authorities, printed nearly in full elsewhere in this issue, the Royal Commission went too far, in that it recommended any sort of a Parliamentary standard.

Instead of a Parliamentary standard, or even a standard set and subject to modification by a central authority, the Committee holds that since "no two cases are precisely similar," a central authority should have power to say what sort of an effluent "any sewage works ought to produce." The object should not be to secure uniform effluents but "to improve or conserve the conditions of the rivers"—quite another matter.

Of course, the Committee believes that all this means a strong central authority, with technical knowledge and with full power to control the character of the effluent from any and all works, and with no overlapping jurisdiction with any other central authority. With this, as well as the other main conclusion of the report, American engineers and sanitary chemists will agree.

Contests in Engineering Society Elections

Most elections in engineering societies, carried on by letter ballot, are tame affairs, as the ticket selected by the official Nominating Committee is voted on without opposition and the result is a foregone conclusion. Occasionally it happens, however, that some candidate named by the official committee will displease a certain proportion of the membership, an independent committee will be organized and another candidate named in opposition. This happened in the recent annual election in the American Society of Mechanical Engineers, and has happened again in the election of the American Society of Civil Engineers, in which balloting is now in progress.

This last contest deserves attention in these columns because of the unusual grounds on which the opposition to the regular candidate is based. The regular candidate, F. A. Molitor, of New York City, is admitted to be an engineer of high standing in the profession and of high ethical standards, interested deeply in the welfare of the profession and of the Society, and in every way competent to fill the position in question. Those who oppose Mr. Molitor base their opposition on the fact that he wrote a letter, published in ENGINEERING NEWS of May 8, 1913, in which he criticized the conduct of the Society's affairs, and enumerated various directions in which, in his opinion, the conduct of the Society could be altered to the advantage of the membership. Mr. Molitor has promptly replied to the circular sent out by those opposing him, stating that he stands by the letter which was published in ENGINEERING NEWS, and if elected to the Board of Direction, will use his influence toward carrying out the changes he has indicated.

So far, the issue would seem to be clear cut, so that the members can vote understandingly, according to their opinions.

It may be worth while to say a word here as to the opinion, which is undoubtedly honestly held by some, that it is not proper for a member of an engineering society to discuss the society's affairs in the columns of a technical journal. This opinion is based, doubtless, on the idea that a technical society is like a family or a social club, whose internal affairs are the business of its own members and of nobody else.

But a great national engineering society is an entirely different sort of organization from a social club of limited membership. The affairs of the American Society of Civil Engineers are of importance and interest, not alone to the thousands of its own members, but to the profession as a whole. Honest and intelligent criticism is a good thing for any organization; and as a matter of fact, the affairs of the national engineering societies have been a frequent subject for discussion in the technical journals ever since the societies were organized and the technical journals were founded.

There is, in fact, no other means by which general critical discussion of the Society's affairs can be freely carried on, since the official publications of the Society are necessarily under such restrictions that they could not give place to such criticisms save in publishing proceedings of the meetings.

It may be said, perhaps, that the place for such criticisms is at the meetings which the Society holds. These meetings, however, for the transaction of general business, occur at long intervals, not more than once or twice a year. The number of members who do or who can attend these

meetings is usually not a tenth or a twentieth of the Society's membership. As a practical matter, therefore, the only means by which a general discussion of the affairs of the Society can take place with free and candid criticism is through the columns of the technical journals.

We could cite instances in which the free discussion in the technical journals of the affairs of other engineering societies than the American Society of Civil Engineers has prevented such societies from adopting unwise policies, and on the other hand, has greatly aided such societies in their development. Under these conditions, it is difficult to see how any sound indictment for disloyalty can be maintained against an engineer because he discusses in the columns of an engineering journal the affairs of the society to which he belongs.

A Derailment Easy to Explain

The Interstate Commerce Commission has just issued an official report on its investigation of a derailment on the Kansas City Southern Ry. on Oct. 19 last. In this accident the locomotive of a passenger train running at 15 miles an hour was derailed, overturned and went down the bank, causing the death of the engineman.

The track on which this derailment occurred was in such bad condition that at some places the gage at the rail joints was 4 ft. 8 in., while at the center of the rail it was 4 ft. 9¼ in. Fifty angle bars were found in a short distance having only one or two bolts in them, while some of the rails had no bolt holes drilled in the webs. Twenty-five angle bars were found within a mile which were broken or badly sheared, and in some cases there were spaces between rail ends as great as 2 in. The rail spiking was so poor that many spikes were loose, some of them standing an inch away from the base of the rail; and in one rail only two spikes out of seventeen on the inside of the rail were holding.

The division engineer in charge stated that the appropriation for the maintenance-of-way department was spent in keeping up the weakest points in order to keep the traffic moving, but was barely sufficient to do this, the condition of the track being substantially the same at the time of the derailment as it had been the year previous, although ten or a dozen derailments had occurred during the year.

There can be no doubt whatever that such a railway track as is described and illustrated in the commission's report is unfit to run trains over. The plea may possibly be made that the railway which allows its track to get in such a condition is forced to do so by lack of funds to properly maintain its road. This defense, however, will not bear analysis. The wear and tear of rolling stock operated over such track, with the loss in accidents that are bound to occur, and the increased expense of moving traffic due to the enforced slow speed, all combine to make the running of trains over a track of this sort the worst kind of extravagance instead of economy.

If a railway company is in such financial condition that it has not the money to maintain its track in reasonably safe condition, its officers should put squarely before the state or the interstate commission their statement that they will no longer assume the responsibility for the operation of the railway unless they are permitted to charge rates high enough to provide earnings sufficient to properly maintain the road. On the other hand, if a railway company diverts funds that should be applied to track maintenance in order to engage in outside operations or pay unearned dividends, then the state authorities having the power to do so should compel necessary repairs to be made as a condition to continuance of operation.

The Importance of the Local Engineering Society

At a recent meeting of the Seattle Association of Members of the American Society of Civil Engineers, a resolution was adopted requesting each technical society in the city to appoint representatives to form a joint committee which should plan for coöperation between the different societies. We recently reported a similar movement in Philadelphia, where the Engineers' Club is taking the lead toward the organization of a federation of all the technical societies of Philadelphia with the Engineers' Club as a nucleus. These movements are typical of the progress being made in a number of different cities toward the strengthening of the local engineering society.

In an address on Dec. 17, at the annual dinner of the Engineers' Club of Youngstown, Ohio, F. E. Schmitt, of the editorial staff of ENGINEERING NEWS, emphasized the importance of the local engineering society to the engineer and to the community. There is no doubt that the enormous growth of the national engineering societies during the last quarter century has to a certain extent operated to reduce the importance and the strength of the local engineers' clubs. It is true that the national societies have the power to do for their members and for the profession many things that would be impossible for the local society. It is equally true, however, that a local engineering society, properly organized and supported, can yield benefits to its members and to the public which are impossible for the national society.

One of the greatest benefits yielded by an engineering organization is the promotion of mutual acquaintance and friendship among the men engaged in similar work. This was a comparatively easy accomplishment a quarter of a century ago, when the profession was small and the field of work which it covered was limited. At that time it was possible for a member of one of the national societies of engineers to be personally acquainted with a considerable proportion of his fellow members. Under present conditions this is no longer possible. The average member of one of the great national societies probably attends one of its general meetings not oftener than once in four or five years, and probably finds then that he knows only a handful of those present. We are speaking now, of course, of the average member and not of the men in the higher ranks of the profession who by frequent travel are brought in touch with fellow members in the profession over a wide range of territory.

In a local engineering society, on the other hand, holding fortnightly or monthly meetings throughout the season, with opportunities for social intercourse as well as technical discussion, it is easily possible for an engineer to become personally acquainted with most of the engineers in his own locality and not only with those working in his own immediate specialty, but with engineers in all branches of the profession.

The governing bodies of the national engineering societies have come to realize during the last few years, that if their societies would become truly national organiza-

tions, they must establish local branches in the principal cities where their members can meet each other. Simultaneously with the organization of these local chapters or sections of the national societies in different cities, however, the members conducting them have realized that it was far better to merge these organizations in a single strong, local engineering society rather than attempt to keep alive three or four weak, struggling sections of the national societies, able to hold only infrequent meetings and with small attendance and interest.

In the city of Buffalo, for example, there has long been a small engineering society, made up chiefly of civil engineers and holding very infrequent meetings, so that the organization has, we believe, become little more than a name. A year or two ago, officers of the American Society of Mechanical Engineers visited Buffalo and brought together the resident members of that society for the organization of a local section. The Buffalo members in charge of the movement, however, shortly perceived that in order to form a vigorous, useful organization, its membership should not be confined to those already belonging to the American Society of Mechanical Engineers, but all members of the engineering profession should be invited to join. The name of the organization, therefore, was changed to the Buffalo Engineering Society and a strong influential society has been developed there.

There are two cogent reasons why the engineering profession needs strong engineering societies in each important city as well as the national engineering organizations. The first is that the local engineering society can often accomplish more for the profession in keeping its work before the public than can the national societies. The second is that the public is more and more looking to influential organizations of engineers for guidance on important public questions; and a strong local engineering society, officered by men of ability and good judgment, can deal with public engineering questions in a city or county or state that could not possibly be handled effectively by a national engineering society.

We would by no means be understood as doubting in any way the importance of the national engineering societies or undervaluing the service they have rendered and can render to the profession. What we wish to emphasize is that the local engineering society, well supported and properly organized, has a far larger field of opportunity and usefulness than has been generally realized.

Letters to the Editor

Engineering Societies and the Coast and Geodetic Survey

Sir—I have noted with interest and pleasure your editorial of Dec. 17, concerning our effort to get proper support for the Coast and Geodetic Survey. I am particularly grateful for your suggestion that the engineering societies might well come to our assistance. I earnestly hope this suggestion may be adopted. The Coast and Geodetic Survey is an organization which merits the approval and support of all engineers and just at present it needs that support urgently. If the societies would report their action to the Chairman of the Committee on Appropriations, House of Representatives, I am sure that the information thus sent him would be appreciated.

WILLIAM C. REDFIELD,
Secretary, Department of Commerce.

Washington, D. C., Dec. 19, 1914.

[We suggest that any engineering society desiring to investigate this matter with a view to action address a request to the Department of Commerce for a copy of Secretary Redfield's annual report, and if fuller information is desired, address O. H. Tittman, Superintendent of the Survey, Washington, D. C.—EDITOR.

Cycles of Rainfall and the New Bedford Records

Sir—In September, 1913, the writer published an article in the Stone & Webster *Public Service Journal* entitled "Cycles of Rainfall." It is thought that this may prove of interest in connection with X. H. Goodnough's article on "A Century Rainfall Record at New Bedford, Mass.," published in ENGINEERING NEWS for Nov. 19, 1914.

In the article on "Cycles of Rainfall" attention was called to several very general methods of analyzing precipitation data, all of which gave somewhat different conclusions and impressions. By chance the New Bedford records up to 1906 were included in that discussion, although the records for the subsequent years, as given by Mr. Goodnough, were not then available.

The writer's conclusions regarding the occurrence of cycles of rainfall were that cycles appear in all records, but that the magnitude and length of time of the departure from the normal is quite variable at different stations. Some records indicate a decreasing rainfall for a given period, while others at no very great distance may perhaps indicate the very reverse for the same period. Needless to say, all comparisons should be over the same term of years. In general, the occurrence of rainfall might be likened to the waves on the ocean, varying all the way from the little ripple to the big wave, with resultant diversity of period and magnitude.

It is probable that the major variations occurring in a record 100 years in length may become minor variations over a period of 1000 years, in just the same manner that we find variations occurring between 10- or 15-year periods and 100-year periods. This is, of course, only a mere guess, but has been substantiated to the satisfaction of some people, by the size of the annular rings in the large trees of California and by recent theories regarding the effect of sun spots.

It is desired to call attention to the fact that the method used by Mr. Goodnough in preparing his Fig. 2 is similar to the one used by the writer in preparing his successive

ten-year averages, the latter method being first developed by the U. S. Army engineers in a recent report on the Merrimac River. A comparison of the two charts will show quite marked differences in the shape of the curves. These differences are of sufficient amount to furnish quite different conclusions regarding the cyclical occurrence of rainfall.

The stations selected in the article on "Cycles of Rainfall" were chosen not only because of their length of record, but also because it was thought that they were located sufficiently near together to enable tracing out some general similarities. A reference to the tables and diagrams in that article will, however, show that even in a relatively short distance, as from Boston to Albany, or Boston to New Bedford, the records may be quite different in their characteristics, and warrant quite different conclusions.

The writer believes that Mr. Goodnough has chosen the right theory for smoothing out the yearly abrupt changes in rainfall by using progressive averages. Whether the three-year period is better than a ten-year or any other length of period is extremely uncertain. It is true, however, that the length of period chosen may affect conclusions materially.

Taking the New Bedford records alone, perhaps the conclusion might be warranted that a period of exceptionally dry years may be expected to continue in the near future. The study of other long-term records, however, would warrant the conclusion that we have already reached the lowest point in the cycle. The writer believes that the safest conclusion is that no man can predict whether the future rainfall over the country as a whole is likely to be lower, equal to or greater than that of the past few years.

He thinks, also, that when other stations are analyzed as well as New Bedford, when considering the theory of probability and chance, it is quite likely that the next few years will yield better runoffs than have the past five years. This statement is meant to apply to total yearly amounts and not to the monthly or seasonal variations, as the writer is not in a position to discuss the latter, or to offer any opinion regarding the question of lower summer runoffs in the future.

DANA M. WOOD.

Stone & Webster Building, Boston, Mass.,
Dec. 11, 1914.

A Graphic Method of Determining Runoff in Storm Sewers

Sir—I have taken great pleasure in carefully going over "A Graphic Method of Determining Runoff in Storm Sewers," by O. Hufeland, in your issue of Nov. 5, 1914.

It might not be amiss to call Mr. Hufeland's attention to a paper entitled, "The Design of Storm Water Drains in a Modern Sewer System," presented by the writer before the Western Society of Engineers, May 18, 1910. The principles there presented are identical with those emphasized by Mr. Hufeland, and were worked out entirely independently and with no knowledge of a similar development by engineers in Europe.

The graphical part of Mr. Hufeland's paper is new to the writer and would appear to be a distinct advantage over some of the methods of computation employed at Kansas City, where the writer's method was developed.

J. B. BALCOMB,
Executive Engineer, Buena Vista Power & Irrigation Co.
Alberson, Ore., Nov. 16, 1914.

Sir—In presenting "A Graphic Method of Determining Runoff in Storm Sewers" in your issue of Nov. 5, O. Hufeland appears to criticize quite severely American practice in sewer design. The writer wishes to agree that the continued use of the old formulas or of any formula may be attributed to one of the unpleasant reasons cited, and the censure given is well merited.

Mr. Hufeland, however, goes further and apparently disapproves of everything written on the subject in the past ten years. He apparently approves of Kuichling's work (published in 1889) but evidently does not appreciate the widespread application of the resulting "rational method." A number of modifications and methods of design following Kuichling have been published in the last ten years and several others are in use in the larger cities. It is probable that with a little more publicity for the newer methods and further public condemnation of the use of formulas, the rational method will be adopted in all offices where sewerage work is in the hands of specialists.

It will be difficult, however, to persuade the engineers in smaller places, who have many other phases of municipal work to consider, to give the proper time to the study of improved methods of sewer design. And this missionary work is not helped by the exposition of methods carried to an extreme of refinement far beyond the accuracy of the data in hand and obviously involving greatly increased labor. It is, therefore, extremely advisable that nothing be published which would tend to confuse the issue in the minds of those studying the subject for the first time.

The method given by Mr. Hufeland is an interesting study. As presented, however, it is not a method which can be applied directly to the design of sewers. The writer has used for some time a method very similar to Mr. Hufeland's in interpreting the results of coincident rain and sewer-gage operations for a *particular storm*.

The vital defect in the method as presented is that the whole system of sewers is designed for a particular storm having a duration of t_r and an intensity of q_r. He fails to give any suggestion as to how the choice of this particular storm for any one sewer system is made. Even if he had laid down a rule for choosing the values for this storm and had designed the system agreeing to the procedure indicated, the result would be that one single piece of sewer would accidentally be designed for critical conditions and that the remaining sections both above and below would be too small. This is evident from the fact that the critical rain for his first branch would be the heaviest rain which could last for a time t_1, and by all the laws of probabilities, this rain would have an intensity much in excess of the value of q_r.

Similarly, the maximum runoff in Section 11 would result from a rain of greater duration than t_r; of duration such that the runoff from all the elementary areas would be contributed at one time. Such a rain would naturally be expected to be of less intensity than q_r, but unless the drainage area were of very unusual shape, the

runoff would be greater than for the conditions given by Mr. Hufeland.

The writer is unable to believe that Mr. Hufeland has correctly interpreted the foreign practice quoted, and would be interested in having this work reëxamined in order that what has been published may be properly supplemented and revised.

W. W. HORNER.

325 City Hall, St. Louis, Mo.

Sir—In your issue of Nov. 5, 1914, there is an article by O. Hufeland on a graphic method of determining storm-water runoff. Mr. Hufeland is entitled to many thanks for his assault upon the exponential formulas, which, like all popular fallacies, die hard, but why thicken that "fog of theories" to 100% opaqueness by importing an ultra-theoretical method?

Mr. Hufeland asks us to assume that the rainfall commences suddenly, continues uniformly and ceases abruptly. He says that a "definite intensity" means a "rate of precipitation which is *substantially* uniform during the period" (the italics are mine), and this definite intensity is the foundation stone of the method.

To anyone who has even an elementary knowledge of the subject, the salient point about rainfall is that it is decidedly nonuniform. Therefore, how is it possible that results predicated on *substantial* uniformity should hit anywhere near the mark?

It is hard to see why this method by Vicari should be advocated when the best practice in America tends toward the use of Mr. Kuichling's Rational Method, which involves no such absurdities in its theory, and which is much easier to use.

It is true that the Rational Method assumes the maximum discharge to take place when the water arrives from the furthest points and that this is not true for all drainage areas with the hypothetical storm assumed by the Germans. It is a fact, however, that in practice the Rational Method is very near the truth. For here in America the general type of storm is characterized by a moderate rate of rain for a short time, then a heavy downpour that lets up more or less gradually and irregularly. For this type of storm, which we naturally design our drains to carry, the maximum discharge actually does occur when the water from the furthest point arrives, and the Rational Method is theoretically and practically correct.

It is, to say the least, inconsistent to talk of a "fog of theories" and then attempt to promulgate the doctrine that the discharge of a lateral is characterized by a period of absolutely uniform increase, then a long period of constant rate of flow and another of absolutely uniform decrease. That such assumptions are the wildest kind of theorizing is apparent to anyone who has watched a sewer during a storm or inspected a gage record.

Mr. Kuichling is quoted as insisting on the use of "actual uniform intensities of rainfall." The writer of this letter once elaborated a method of computing runoff which was designed to remove some of the theoretical deficiencies of the Rational Method. As a consequence, he enjoyed the acquaintance of the late Mr. Kuichling and obtained his opinions on the subject direct. Neither by any spoken word nor in any published account can he recollect any such statement. The rate of rainfall used in the Rational Method is the *average* rate of rainfall during the period of concentration, irrespective of whether that intensity was constant or varied.

Mr. Kuichling did, however, urge runoff investigators to pay particular attention to those rare intervals when the rainfall is constant or nearly so for a time, for he considered that in this way only could the value of the coefficient of imperviousness be obtained. His insistence was that these values should be rationally obtained and poor guesswork eliminated. The wisdom of this can be appreciated by referring to the values given by Mr. Hufeland. Roofs that shed only 80% of a hard rain are certainly in need of repairs, and pavements classified as "waterproof," which retain 30% of heavy precipitations, demand a graft investigation.

CARL H. NORDELL,
Assistant Engineer, Sewerage Commission.
Milwaukee, Wis., Nov. 24, 1914.

Sir—The article on "A Graphic Method of Determining Runoff in Storm Sewers," which appeared in ENGINEERING NEWS, Nov. 5, 1914, is of particular interest to the writer, who has been studying this subject somewhat of late.

Even a slight investigation of the common formulas for runoff reveals their crudeness for use in rational engineering designs, unless they are based on some local conditions unknown to the average engineer, which make them applicable only under the conditions assumed.

One part in the paper is not entirely clear to the writer. The method seems to cover a design which is correct for only one storm of a given uniform intensity for a given or assumed period of duration. What would be the effect upon the design if the storm were of shorter or longer duration with correspondingly greater or lesser rates of precipitation? If the rate of precipitation in inches per hour were a linear function of the period for which that rate were constant, the effect of different storms might be practically negligible. However, the rate of precipitation is not a linear function of the time as is evident from the published curves, showing the observations made in numerous localities.

If my understanding of the graphic method is correct, Fig. 3 or Fig. 4 of the paper can be made applicable to storms of other durations than that assumed in the example by decreasing or increasing the length t_r and using a new vertical scale proportional to the new rate of precipitation. This can be easily done by shifting the curve $A'K'$ to a parallel position. But this will change the location of the maximum ordinate NL, since the points N and L will no longer be in the same vertical. A new maximum ordinate must, therefore, be found for the new condition, and its value, reduced or increased in proportion to the change in the rate of precipitation, compared with the first value obtained. For example, if t_r were reduced, say 20%, or from 20 min. to 16 min., the ordinate NL would be reduced perhaps 10%, while the rate of precipitation might be increased 15%, leaving roughly 5% to be provided for by increased capacity. The section l_{11} still need only be designed for the same capacity as l_9, as shown in the paper.

Now suppose the duration of the storm to be increased 50%, then t_r would be increased 50% and NL might be increased about 25%, while the rate might be decreased only 20%, leaving 5% increase in capacity to be provided for by change in the design. But in this case the section

l_{11} will carry a greater quantity than l_9, since the maximum ordinate extends into section (11) of the flow diagram.

It would, therefore, seem to the writer that a complete analysis of the problem would require an extension of the diagram by adding parallel positions of the curve $A'K'$ (Fig. 4) for periods varying by five or ten minutes, from storms of very short duration, which might alter the design of some laterals, to storms having a duration equal to the time required for water to flow from the most remote inlet through the entire length of the sewer. A comparison of the corrected values of the maximum ordinates for the several positions of the curve $A'K'$ will then give the absolute maximum capacity required for the correct design of the sewer. It should be noted that the method set forth by Mr. Hufeland is admirably adapted for the investigation of the effect of various storms, as the labor of finding the length of the maximum ordinate for any storm is very small after the diagram has once been constructed.

Such an extension of the diagram as that suggested above might result in designing a sewer "gradually increasing in size to the outlet," especially when the duration of the storms considered is equal to the time of flow through the sewer and the rate of precipitation is heavy.

R. D. GOODRICH,
City Engineer.

Cheyenne, Wyo., Nov. 12, 1914.

[Replies by Mr. Hufeland to each of the foregoing letters follow.—EDITOR.]

Sir—I am under obligations to J. B. Balcomb for calling my attention to his paper of 1910, one of the few that I had not seen when I wrote my article. It is interesting in this connection because of the cumulative method which he describes and which resembles the Vicari method in that he draws curves for each drainage unit and adjusts their relation to each other to correspond to the time required for the flow from one unit to reach the next. On page 6 of his paper he says:

> A rigidly rational method would consider each sewer an entity—treating it as though it were the only storm drain in the city. This would mean determining the time of surface concentration, the perviousness of the surface, the frequency with which it would be permissible to flood it, a precipitation curve suited to its individual characteristics, etc.

With the method described by me every one of these requirements can be provided for with the minimum expenditure of labor.

Answering W. W. Horner, I do not "disapprove of everything written on the subject in the past ten years." I am also aware of the seven or eight modifications of Mr. Kuichling's work, some of which caused rather explosive comments from that lamented friend. My "disapproval," so far as such a presumptuous word is permissible, is confined to the publication of complicated formulas involving abstruse mathematical computations that are based on a few reliable data. A thirty years' experience in sewerage practice and a personal acquaintance with some of those who write these papers led me to know the value of some of this literature. Far from criticizing American *practice*, I am only criticizing American *theory* as it is represented in such papers.

The third paragraph of Mr. Horner's letter involves matter that is a subject of personal opinion and I concede his right to hold the opinion there expressed. The charge that the method proposed is one of "extreme refinement, etc.," embarrasses me somewhat because some of the comments made to me complain of the reverse.

I have answered Mr. Horner's letter so far as it relates to the personal views expressed in the article, but a discussion of the Vicari method would take more room than could be devoted to it in a letter. I do wish to call attention, however, to the fact that the correctness of the graphic method described has nothing to do with the storm selected, nor with the percentage of runoff, nor with the velocity formula used. The article clearly states that its use is based on the "acceptance of the postulate 'that a definite intensity of rainfall during a definite period must result in a definite maximum of runoff, but that this maximum does not necessarily occur when the runoff from the whole area reaches a given point in a collecting sewer.' A definite intensity means, of course, a rate of precipitation which is substantially uniform during the 'period,' etc." If it is correct to use the data available in the above way, the result given by the graphic method should be correct. I will concede that some engineers do not believe that the quantity of storm water reaching a sewer can be determined in so direct a manner. Mr. Kuichling was one of those who did and the writer agrees with him.

At some other time I hope to be able to furnish data justifying the latter view.

Carl H. Nordell's letter evinces a degree of heat that does not seem to be warranted by the criticisms which he makes. I am quite familiar with the "Additive Method of Runoff Determination of Storm-Water Sewers" which he presented to the Municipal Engineers of New York in 1909. While very painstaking, it was an effort to prescribe a theory based on very few data, resulting in a theoretical rainfall curve and a slide-rule for sewer computation (now in the market), based more or less on this curve. With the adoption of any other method, particularly if it is one that, due to its simplicity, may find a larger application, his theory and slide-rule will suffer more or less from desuetude.

Of course every writer on this subject today talks of the rational method, and many juggle with Mr. Kuichling's name in connection with it, often, as I have said in my answer to W. W. Horner's letter, to Mr. Kuichling's sorrow and anger. To soothe Mr. Nordell in that respect, I will inform him that Mr. Kuichling read my article, took down his copy of Hütte of the date of 1909, said he had seen the method, and his marks in the book proved it, but had dismissed it because at the first glance it seemed to be based on a table of runoff that he thought was wrong. In that respect he was like Mr. Nordell, who also objects to the runoff, but when I pointed out to Mr. Kuichling that those figures "had nothing to do with the case" he, unlike Mr. Nordell, looked again and said in his emphatic way, "It's a darned good thing." That illustrates one difference between Mr. Kuichling and Mr. Nordell. The latter accuses me of making a definite intensity the foundation stone of the method. I admit it.

Whether I have "even an elementary knowledge of the subject" of rainfall, as compared with the inferentially exceeding great knowledge of Mr. Nordell, is not for me to determine, but I hope in the near future to lay before the engineering profession a careful analysis of a very

long period of rainfall records from self-recording gages which may interest those who still have something to learn of this vexed subject. Unfortunately, I do not deserve the credit for the method with which Mr. Nordell finds so much fault, but have merely made accessible to some engineers a not altogether new help in computation. As I have said in my article, it is a free translation and the credit for it or the lack of "even an elementary knowledge of the subject" must fall on K. Meier, Chief Engineer of Sewers in the city of Berlin, Germany, who wrote the original in "Hütte." My guilt is confined to the "importing," as Mr. Nordell expresses it.

R. D. Goodrich's understanding of the method is quite correct. Not only the maximum flow for the whole area, but the flow through any of the laterals at any period of the storm, will be represented by the ordinate for the time required.

One gratification furnished by the letters on this subject that have reached me is the conviction that the exponential formula is rapidly going to its long deserved obsolescence.

O. HUFELAND.

Municipal Building, New York City, Dec. 21, 1914.

NOTES AND QUERIES

The thickness of the asphalt pavement on the Junipero Serra Boulevard, San Francisco, Calif., is 2½ in. and not 3 in., as stated in the caption under Fig. 3, p. 1182, in our issue of Dec. 10, 1914. Also, through an oversight, the author referred to the bituminous rock deposits in the vicinity of Santa Cruz as bituminous limestone. These deposits are bituminous sandstone.

On Establishing and Enforcing a British Standard for Sewage Effluents

A brief but important British report on a standard for sewage-works effluents and means for the enforcement of such a standard, has been made public. The committee was selected by the Association of Municipal Corporations and its members were chosen "for their skill in the design and maintenance of sewerage and sewage-disposal works." The report was submitted, on behalf of the committee, by its chairman, John D. Watson, Engineer to the Birmingham, Tame and Rea District Drainage Board, Tyburn, Birmingham, England.*

The deliberations of the committee were on the recommendations of the Royal Commission on Sewage Disposal dealing with standards of purity (Summary of Conclusions, par. 62, p. 17, Eighth Report; see ENGINEERING NEWS, Jan. 9, 1913).

After introductory statements the committee declared that although it believed British legislation on stream pollution (Public Health Act, 1875) "is greatly in need of amendment," yet "it is not desirable that standards of purity be prescribed by Parliament as the Royal Commission recommend." The remainder of the report, which is also the substance of the document, reads as follows:

4. The discussions established the fact that the Committee are in complete agreement that the law as it stands is greatly in need of amendment, but that it is not desirable that standards of purity should be prescribed by Parliament as the Royal Commission recommended.

5. The predominating factor in considering the advisability of creating a standard by Act of Parliament is the fact that no two cases are precisely similar. Differences manifest themselves in the character and volume of the stream into which the sewage effluent is discharged, and in the strength and characteristics of the sewage itself. In practice it is found that the strength of the sewage varies considerably even during a day of 24 hours, that no bacteria bed or irrigation field emits effluents of unvarying quality, and that it is unreasonable to expect a purification plant of excellent design and ample capacity to give as good results during a time of abnormally cold weather as it would during a normal season. If such a plant were large enough to produce a standard effluent in mid-winter, it would obviously be too large and expensive to meet the demands of the statute at other seasons, and vice versa.

6. In view of these varying conditions, the Committee think that it should be left to a central authority possessing adequate technical knowledge and power to determine finally all disputes, whether with public authorities or private persons, relating to the quality of sewage effluents, effluents from storm-water tanks, or any other liquid discharges into tidal rivers, streams, canals, ponds or lakes, and to settle any incidental questions, such as the amount of compensation or damages. Such central authority should not only have power to indicate the quality of the effluent which any sewage-works ought to produce, but should also have power to make regulations as to how and when samples should be taken for the purpose of ascertaining whether such effluent is produced.

7. The Committee have come to this view with reluctance, as they are aware of the prevalent objection to multiplying Government Boards, but they see no workable alternative to giving a Government Department absolute power to determine what must be done in individual cases, unless setting up a standard of purification by Act of Parliament. The latter course they believe to be quite impracticable, and any suggestion to make it less impracticable, by authorizing the central authority to override the statute in the interest of a municipality for any reason whatever, would probably be unsatisfactory even to the community in whose interest the concession is made.

8. Any amendment of the law should be to improve or conserve the condition of the rivers, and not to compel municipalities to discharge sewage effluents of uniform quality. The authority of the central authority should be paramount, and every municipality should be obliged to accept their dictum as to what is necessary; not, however, until a careful and unbiased inquiry into all the circumstances of each case has been made. As the judgment of the Local Government Board in reference to size and form of tanks, capacity of bacteria beds, etc., is now accepted, so should the decision of the central authority be accepted, in all matters relating to the pollution of rivers; and as the Local Government Board have power to vary their requirements as a condition of sanctioning a new loan, so should the central authority have power to vary their requirements as a condition of assuming responsibility for allowing effluent to enter a stream.

9. Whether the central authority should be affiliated with the Local Government Board, or with a new department under a Public Health Minister, it is not for this Committee to discuss here, but there should be no overlapping, and it should not be possible for one authority to order works to be constructed which another authority might deem useless or redundant.

10. The Committee believe that a central authority could greatly help municipalities by establishing and maintaining a national research department.

Sewage Disposal for Indiana Cities by discharging the sewage into the Chicago drainage canal instead of into Lake Michigan has been proposed by the Sanitary District of Chicago as a means of reducing the pollution at the southern end of the lake. The cities in question are Whiting, Hammond, East Chicago and Gary, and the Sanitary District has offered the use (without charge) of the new Sag Canal, which is now being built from the Calumet River to the main drainage canal. The cities will vote in a few months on the acceptance of this proposition, which will involve a rearrangement of the sewers and the construction of the necessary connections.

*Among the other members of the committee were Gilbert J. Fowler, of Manchester, Geo. A. Hart, of Leeds, Joseph Garfield, of Bradford, and E. G. Mawbey, of Leicester. The report was dated Oct. 3, 1913, but was not made public until a few weeks ago. The report was addressed to H. G. Pritchard, Secretary, Association of Municipal Corporations, 9 Bridge St., Westminster, S. W., England.

The Failure of the Hippodrome Arcade, Youngstown, Ohio

On Oct. 26, 1914, a section of the reinforced-concrete part of the new Hippodrome Building, under construction in Youngstown, Ohio, collapsed and carried down in the débris a number of workmen, three of whom were killed in the accident. ENGINEERING NEWS has refrained from any discussion of the design or construction of this building, or of the causes of its failure until the results of official investigations might be available. It now appears extremely unlikely that any such official investigations will take place, so an effort has been made to procure all possible information regarding the building with a view to establishing, if possible, the cause of the failure.

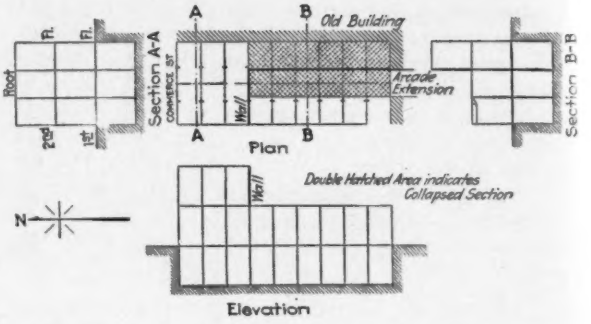


FIG. 1. OUTLINE PLAN AND SECTIONS OF THE HIPPODROME BUILDING ARCADE, YOUNGSTOWN

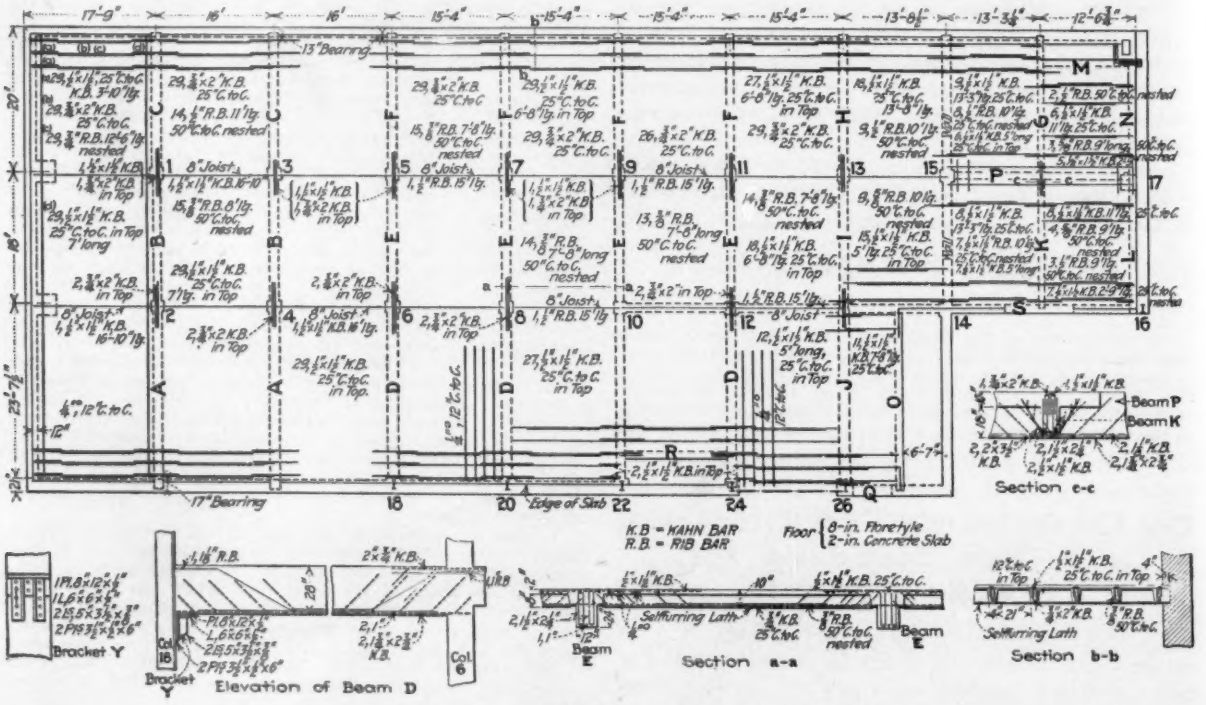


FIG. 2. DETAILS OF FIRST FLOOR, HIPPODROME ARCADE

The following data regarding the design of the building are authoritative, inasmuch as they are based on drawings and computations freely offered to the investigator. The statements regarding the construction of the building on the other hand, while made only after the most studied effort for accuracy, are subject to the doubt which must affect all *ex-parte* testimony and eye-witness statements.

GENERAL DESIGN

The Hippodrome Building, in Youngstown, is a steel theater structure, having at one side of the main auditorium an arcade and office building, mainly two stories and basement in height, which opens on Commerce St. at one end and which at the other end is reached from Federal St. through an arcade built part way in an old structure facing Federal St., and the rest of the way in the new Hippodrome addition.

As originally designed, the whole building (theater and arcade addition) was of steel construction. Some time after the letting of the contract, however, the contractors,

TABLE I. GIRDER SCHEDULE FOR FIRST FLOOR

Concrete				Steel				Concrete				Steel			
Mark	No.	Section, In.	Tee, In.	No.	Size, In.	Length, Ft.-In.		Mark	No.	Section, In.	Tee, In.	No.	Size, In.	Length, Ft.-In.	
A	2	13x28	34	2	2x3½K.b.	24-9		J	1	13x28	26	2	1½x2½K.b.	23-6	
				1	1R.b.	30-0B.						1	1R.b.	20-0B.	
				2	½R.b.	18-3N.						1	½R.b.	18-0	
B	2	12x24	19	2	1½x2½K.b.	18-0		K	1	10x24	24	2	1½x2½K.b.	18-0	
				2	½R.b.	28-0B.						1	½R.b.	23-3B.	
C	2	13x24	32	2	1½x2½K.b.	19-2		L	1	10x16	20	2	1½x2½K.b.	18-0	
				1	½R.b.	24-9B.						1	½R.b.	22-0B.N.	
				2	½R.b.	14-6N.		M	1	10x16		2	x2K.b.	13-2	
D	3	13x28	30	2	1½x2½K.b.	23-6		N	1	10x16	22	2	x2K.b.	16-3	
				1	1½R.b.	29-0B.						2	½R.b.	20-0B.	
				2	1R.b.	18-6		O	1	10x19	26	2	1½x2½K.b.	24-6	
E	3	12x24	18	2	1½x2½K.b.	18-0						2	½R.b.	18-0N.	
				1	1R.b.	28-0B.		P	1	12x28	52	2	2x3½K.b.	25-9	
E,	1	12x24	26	2	1½x2½K.b.	18-3						2	1½x2½K.b.	25-9N.	
				1	1R.b.	24-9B.						2	1½R.b.	27-2B.N.	
F	4	12x24	30	2	1½x2½K.b.	19-2						2	½x1½K.b.	6-6	
				1	1R.b.	24-9B.N.		Q	1	21x10	0	2	½x1½K.b.	7-0	
				1	½R.b.	15-0		R	1	8x14	0	2	½x1½K.b.	15-6	
G	1	10x24	24	2	1½x2½K.b.	19-2		S	1	13x28	0	2	1½x2½K.b	10-0	
				1	½R.b.	24-9B.		K.b. = Kahn trussed bars.							
H	1	12x24	28	2	1½x2½K.b.	19-2		R.b. = Deformed bars (no stirrups).							
				1	1½R.b.	24-9B.		B. = Bent up over supports.							
I	1	12x24	18	2	1½x2½K.b.	18-0		N. = Nested in prongs of stirrups.							
				1	½R.b.	28-8B.									

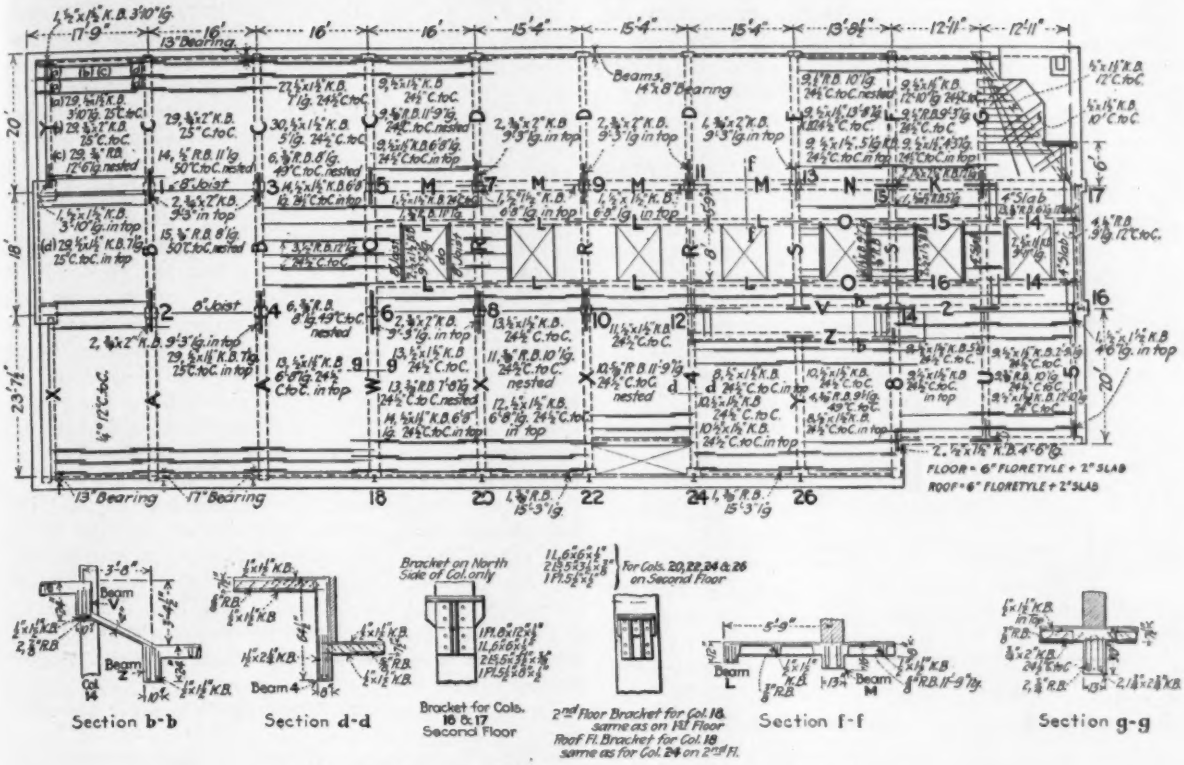

Beams, 14"x8" Bearing
13" Bearing
17" Bearing
8" Joist
FLOOR = 6" FLORETYLE + 2" SLAB
ROOF = 6" FLORETYLE + 2" SLAB
Section b-b
Section d-d
Bracket for Cols. 16 & 17 Second Floor
2nd Floor Bracket for Col. 18 same as on 1st Floor
Roof Fl. Bracket for Col. 18 same as for Col. 24 on 2nd Fl.
For Cols. 20, 22, 24 & 26 on Second Floor
Section f-f
Section g-g

FIG. 3. DETAILS OF SECOND FLOOR, HIPPODROME ARCADE

with the full approval of the architects and of the architects' engineer, changed the design of the arcade addition to reinforced concrete. Work was proceeded upon on this basis.

The building was designed by Knox & Elliott, architects, of Cleveland, Ohio, who had for their structural engineer, J. C. Spencer, M. Am. Soc. C. E., also of Cleveland. The reinforced-concrete design for the arcade was made by the Trussed Concrete Steel Co., and approved by the architects. The building is being erected by the George A. Fuller Co., under the direction and inspection of the architects.

The arcade addition is in plan a rectangle, 151 ft. long and 62 ft. wide, and has in its main section two stories and a basement, the first floor being at the street level. The framing is complicated by the central arcade, but can be understood from the following description and a study of the accompanying drawings.

In general, the building is divided into three bays across its narrow portion and nine bays along its length. The arcade extends north six bays from the south end of the building. The northerly three bays are all two stories and basement high, but in the southerly six bays the easterly bay is two stories and basement high, and the westerly two bays, one story and basement high, with the arcade in the center bay. The west and south sides of the second story of the building have brick curtain walls pierced with numerous window openings and resting on the reinforced-concrete beams of the frame.

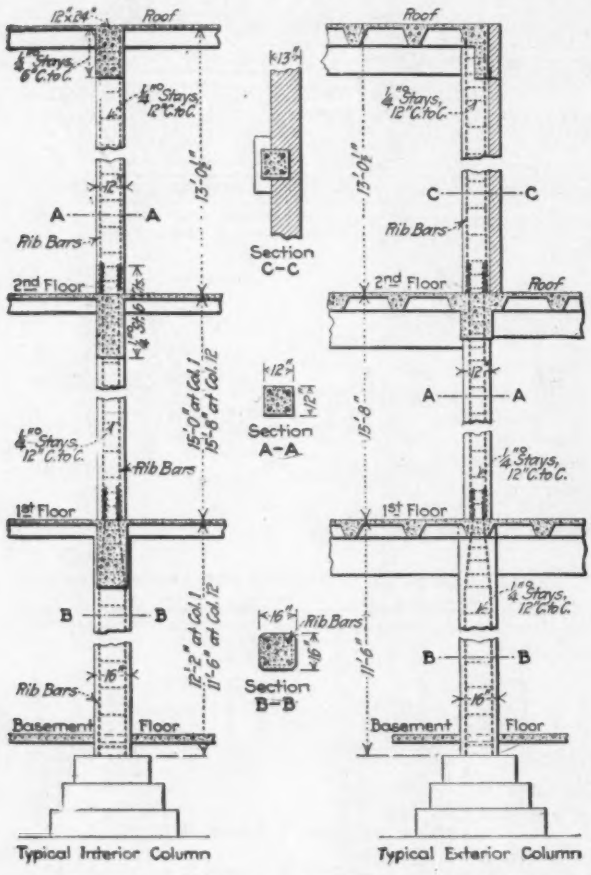
TABLE II. GIRDER SCHEDULE FOR SECOND FLOOR

Concrete				Steel			Concrete				Steel		
Mark	No.	Section, In.	Tee, In.	No.	Size, In.	Length, Ft.-In.	Mark	No.	Section, In.	Tee, In.	No.	Size, In.	Length, Ft.-In.
A	2	12x28	28	2	1½x2½K.b.	25-0	U	1	10x19	27	2	1½x2½K.b.	20-0
				1	1R.b.	27-0B.					2	½K.b.	15-0N.
				2	½R.b.	18-6N.	V	1	10x24	23	1	1½x2½R.b.	29-4
B	2	10x22	20	2	1½x2½K.b.	18-0					1	1½x2½K.b.	29-4
			1	½R.b.	28-0B.						1	½R.b.	32-0B
C	3	10x24	24	2	1½x2½K.b.	19-6					2	½R.b.	22-6N.
			1	½R.b.	21-6B.	W	1	13x30	26	2	1½x2½K.b.	23-6	
			2	½R.b.	14-6N.					2	½R.b.	18-6N.	
D	3	10x24	22	2	1½x2½K.b.	19-6					1	½R.b.	26-2B.
			1	½R.b.	21-6B.	X	1	12x24	25	2	1½x2½K.b.	24-0	
			2	½R.b.	14-6N.					1	½R.b.	24-9B.	
E	1	10x24	21	2	1½x2½K.b.	19-6					2	½R.b.	18-6N.
			1	½R.b.	21-6B.	Y	1	12x22	15	2	½x2K.b.	19-0	
			2	½R.b.	14-6N.					2	½R.b.	14-6N.	
F	1	10x24	18	2	1½x2½K.b.	19-6					1	½R.b.	15-6
			1	½R.b.	21-6B.	Z	1	10x24	36	1	2x3½K.b.	29-6	
			2	½R.b.	14-2N.					1	1½x2½K.b.	29-6	
G	1	10x24		2	½x2K.b.	19-6					1	½R.b.	30-8B.N.
				1	½R.b.	15-0	2	1	8x59½	0	2	1½x2½K.b.	26-2
				2	½R.b.	15-0N.					2	½R.b.	34-0B.N.
H	1	10x19	21	4	1½x2½K.b.	19-6					19	½rd.*	8-7B.
				2	½R.b.	15-0N.	4	1	8x64½	0	2	1½x2½	23-6
J	1	10x12	0	2	½x1½K.b.	9-0					1	½R.b.	29-0B.
J	1	10x12	0	2	½x1½Kb.	6-3					17	½rd.*	10-11B.
K	1	13x24	51	2	2x3½K.b.	26-2	5	1	10x16	0	2	½x2K.b.	20-0
				1	1½x2½Kb.	26-2					1	½R.b.	15-0
				1	½R.b.	28-0B.	6	1	8x14	0	2	½x1½K.b.	15-6
				2	½R.b.	20-0N.	7	1	12x24	23	2	1½x2½K.b.	26-8
L	8	8x12	0	2	½x1½K.b.	15-3					1	½x2K.b.	26-8
M	4	13x16	13	2	½x2K.b.	15-3					2	½R.b.	28-5B.N.
N	1	13x16	13	2	½x2K.b.	13-8	8	1	13x24	30	2	1½x2½K.b.	25-0
O	2	8x12	0	2	½x1½K.b.	13-8					1	½R.b.	26-6B.
P	2	8x12	0	2	½x1½K.b.	9-11					2	½R.b.	18-6N.
Q	1	13x23½	16	2	1½x2½K.b.	18-0	9	1	12x25½	18	2	1½x2½K.b.	25-0
				1	½R.b.	28-0					1	1½R.b.	25-11B.
				2	½R.b.	13-6N.	10	1	12x25½	0	2	½x2K.b.	17-10
R	3	10x19	13	2	½x2K.b.	18-0	11	1	12x25½	0	2	½x2K.b.	19-2
				1	½R.b.	13-6					1	½R.b.	20-10B.
S	2	10x19	15	2	½x2K.b.	18-0	*18 in. c. to c.						
				1	½R.b.	13-6							
T	3	10x19	13	2	½x2K.b.	18-9							
				1	½R.b.	13-6							

REINFORCED-CONCRETE DESIGN

The reinforced-concrete design comprises columns spaced in fairly uniform bays, carrying transverse girders which, in turn, carry the closely spaced beams of a beam-and-slab floor. The only variation from a normal reinforced-concrete frame is caused by the exterior wall

conditions. The west wall is the curtain between the theater and the arcade and is carried on the steelwork of the theater; the reinforced-concrete girders of the arcade frame into the steel columns of the theater and rest on brackets provided for that purpose (see Fig. 3). The north or street wall is carried on pilasters into which the various floors frame. The east wall is a brick bearing wall with notches, in which rest the girders and slabs of the floors. The design here calls for 13 to 14 in.



Story	Mark	Section, In.	Vertical Rods
Roof	All	12x12	4 ⅝-in. R.b.
2nd Floor		12x12	
	1-4		4 1-in. R.b.
	IA, 2A, 5, 7-14		4 ⅝-in. R.b.
	6		6 1-in. R.b.
1st Floor		16x16	
	1-4		4 1⅛-in. R.b.
	5. 8,10, 12,14, 15		4 ⅝-in. R.b.
	6		6 1-in. R.b.
			2 ⅝-in. R.b.
	7, 9, 11, 13		4 ⅝-in. R.b.

All rods stayed with ¼-in. rounds spaced 6-in. and 12-in., as shown in drawing.

FIG. 4. COLUMN DETAILS

bearing for each girder and at least a 4-in. bearing for all slabs. The south wall is the old brick wall of the adjoining building. In the westerly panel, there being a stairway well in the northeast corner, the floor was carried in grooves cut in this wall, but the middle panel was to be carried on steel columns provided for the purpose. The construction at this point is quite critical and is described in detail later in this article.

COLUMNS—The column details are shown in Fig. 4. They rest on prismatic footings of low unit pressure and are reinforced at the four corners with straight rods tied together every 12 in. with wire. They vary from 16x16 in. in section in the basement floor to 12x12 in. in the second floor. The columns in the theater section wall, that is, the west side of the arcade, are of steel H-sections and carry on their other side the framing for the theater floors. They are provided on the arcade side with brackets (see Fig. 3), having a 6-in. outstanding leg, on which rests the girder.

GIRDERS—The girder schedules for a number of the girders are shown in Figs. 2-3. These are typical. The girders are reinforced with straight rods with integral stirrups (Kahn type) and, where required, by deformed bars, nested in the pronged bars and bent up to go over the supports. In other girders continuity is provided by one or more separate Kahn bars, turned upside down and placed in the upper part of the beam over the column. At both the east and west walls the girders have only a bearing with no very effective steel continuity into the wall or column; they are figured as semi-continuous for these two outside panels.

FLOORS—The floor-slab detail is shown in Fig. 2. The intermediate beams of the floor slab are parallel to the long side of the building and frame into the main girders, and continuity over those girders is taken care of by rods in the upper part of the beams. The slab is formed by the so called "floretyle," that is, the opening is made by a pressed-steel continuous form, which gives the required shape.

LOADS AND STRESSES—The design was made according to the following specifications:

Span length, center to center of span;

f_s = 16,000 lb. per sq.in.;

f_c = 700 lb. per sq.in.;

Shear in concrete = 60 lb. per sq.in.;

Compression in concrete in columns, 500 lb. per sq.in.;

Moment coefficient of partially continuous span, one-ninth; fully continuous, one-twelfth; negative moment over support, fully continuous beams, one-twenty-fourth.

Figuring live loads for columns, 25% reduction is made for the second floor and a 30% reduction for the first floor.

The loads on the first floor for floor design were 150 lb. live load + 16 lb. for floor finish + 5 lb. for ceiling; for the second floor, 100 lb. live load + 16 lb. finish + 5 lb. ceiling; and for the roof, 40 lb. live load + 26 lb. finish + 5 lb. for the ceiling.

All beams and columns were figured according to the principles laid down in the report of the Joint Committee on Concrete and Reinforced Concrete, following the above noted specifications. The editors of ENGINEERING NEWS have not checked the whole design, but they have checked a number of the members, both beams, columns and slabs, and have found that they are designed within the specifications laid down above.

COLUMNS 16 AND 17—With one exception, the design was followed in construction. This exception is, however, rather important and should be noted in detail.

The plan in Fig. 3, which in this respect at least is a fac-simile of the concrete drawing, shows the 2d floor columns 16 and 17 at the south entrance to the arcade. The detail in Fig. 3 shows also the bracket provided on the reinforced-concrete drawings to carry Beams K and 2 on Columns 17 and 16, respectively. The steel columns at these points were provided in the original design to carry

not only the steel-beam framing of the arcade, but also a new lintel over the arcade under the old wall of the building, which lies to the south of the arcade. The steel drawings, which were turned over to the reinforced-concrete designers, showed steel columns at this location and they assumed that such were required, and therefore left the column design as it was and provided steel brackets onto which to rest the concrete beams.

The construction was proceeded with upon this basis. The steel columns shown were detailed by the engineer, ordered, fabricated and brought to the job, as was also

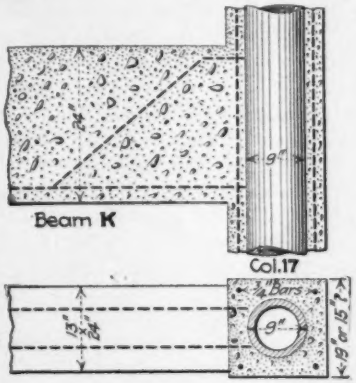


FIG. 5. SKETCH OF CONNECTION OF BEAM K TO COLUMN 17, AS BUILT

the steel I-beam lintel. When construction reached this point, however, and the brick wall was pierced, it was found that it had been carried across this space on an I-beam lintel and there were in the location of these steel columns two 9-in. cast-iron columns on which the steel lintel rested. After due consideration on the part of the architect and the engineer, but without consultation with the reinforced-concrete designer, it was decided to clear out the brick wall from around the cast-iron columns, to incase them with concrete and to rest Beams K and 2 on this concrete.

Testimony is somewhat vague as to the precise method by which this connection was made, but according to our best information the sketch in Fig. 5 shows the condition at Column 17, which presumably was duplicated at Column 16. It will be seen that the 9-in. cast-iron column was incased with concrete to make a square 19-in. column (other testimony is to the effect that this incasement made only 15 in. square), which concrete incasement was reinforced with four ¾-in. rods, one in each corner of the square. Into this the 13x24-in. Beam K was framed, having for its sole bearing the 5 in. (or, according to the other evidence, 3 in.) on the concrete casing of the cast-iron column feebly reinforced by the slender rods. The reinforcement of Beam K was continued up to as close as possible to the cast-iron column, which incidentally had its top some inches above the top of Beam K.

CONSTRUCTION

Construction of the concrete portion was started early in September and the various parts were begun on the following dates: Basement columns, Sept. 22; first floor, Sept. 23; second floor, Oct. 2; roof concrete, about Oct. 19; roof covering of cinder concrete, Oct. 24. On Oct. 26, at 4:45 p.m., that part of the reinforced-concrete structure lying east of the west arcade columns and south of the transverse arcade wall (shown in the plan in Fig. 1) collapsed without apparent warning. The collapse was complete from roof to cellar and the testimony of eye witnesses is so vague and confused that it cannot be determined in what part of the structure failure started nor in what manner it progressed. The five columns (numbered 7, 9, 11, 13 and 15) in the collapsed zone were thrown down, except that a stump of Column 7 remained standing. The girders at the east wall were pulled clean from the wall, as was to be expected inasmuch as their connection there was one of bearing and not of reinforcement. The girders on Columns 6, 8, 10, 12 and 14 were sheared off quite clean at the column head, and the rods which extended up into those columns and over the column head to insure continuity were pulled clean from the concrete of the beam. The plane of the floor slabs in the débris sloped down from either side of the break. The breaks at Columns 17 and 16 were clean, with no indication of any rod tie into the concrete surrounding those columns. Testimony is not clear as to whether the concrete casing of the cast-iron Columns 16 and 17 were sheared off beneath the bearing of the beams which framed into them or whether the break was in effect a continuation of the plane of the column casing.

MATERIAL—The cement used in the structure was the Alpha brand, which was tested by the Pittsburgh Testing Laboratory and which passed with a good margin all the standard specifications for portland cement.

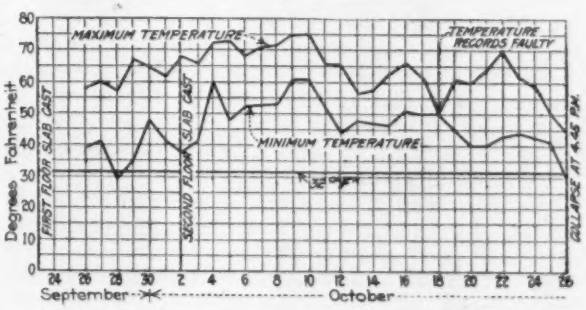


FIG. 6. TEMPERATURE RECORD, YOUNGSTOWN, OHIO, SEPT. 23-OCT. 26, 1914

The aggregate was a separated sand and gravel coming from the local pit of the Concrete Stone & Sand Co. This aggregate is decidedly subject to suspicion. The testimony of a number of competent engineers in the Youngstown district is to the effect that it has a decided tendency toward loaminess and that it should never be used for reinforced-concrete work. So far as we were able to discover, it never had been used previous to this construction in reinforced-concrete work, although it has been used for concrete on street-paving work in Youngstown. The building inspector of the City of Youngstown states that he inspected the sand for the Hippodrome job and never found more than 4% loam, the inspection being the ordinary rough test in a graduated glass of water. The reinforcing steel was furnished by the Trussed Concrete Steel Co. There seems no reason to believe that this steel is in any way responsible for the failure.

The concrete was mixed in a batch mixer and in 1:2:4 proportions, and chuted into place from the high adjoining roof of the theater building. The chute was at a steep angle so that it was not necessary to add any great excess of water to make it flow freely. The temperature

during the laying of the concrete is shown in the accompanying Fig. 6, which record is taken from a local newspaper's recording thermometer for three-hour intervals throughout day and night, except for the period each week from 3 p.m. Saturday to noon, Sunday, when no record was taken. From this it will be seen that just after the casting of the basement columns was a three-day period of quite low minimum temperature, with at least one day below freezing. From that time on until the day before the collapse, however, the thermometer was well above freezing. A cold spell set in the day of the collapse, and snow fell that night.

STRUTS—The struts to support the floor consisted of 4x4-in. sticks spaced about 4 ft. c. to c. in both directions and braced with at least one horizontal line of plank.

The question of strut removal under the floors is an extremely delicate one. Everyone connected with the building admits that the struts under the first floor, that is, the basement struts, were removed entirely at least a week before the collapse. It is agreed also that the struts were still under the third-story roof. There is, however, some question about the struts under the arcade roof and the second floor; that is, the struts in the street story. The contractor's superintendent states that while some of the struts at the north end of the building (the portion which did not collapse) had been removed on the day of the collapse to allow the taking down of box forms preparatory to putting up the ceiling, he is emphatic in his statement that none of these struts under the collapsed portion of the second floor had been removed up to the time of the collapse. The city's assistant building inspector states that at nine o'clock on the morning of the collapse (the last time he was on the job before the failure) some workmen were taking down some of the struts in the collapsed portion of the first floor, but were taking them down one at a time in order to permit the removal of some of the box forms under the beams and slabs, and were replacing the struts as the boxes were taken out. Some outside engineers state that at three o'clock on the afternoon of the failure they noticed carpenters removing some of the struts on the street floor under the collapsed portion of the building, but they are unable to testify certainly that those struts were not replaced one by one as they were taken down. That part of the building which remained standing after the collapse was fully strutted.

CONCRETE—Specimens of concrete from the fallen floors and columns are not entirely satisfactory, although there are no available tests from which its strength might be determined. However, there are now some pieces of concrete in evidence into which eight- and ten-penny spikes were driven the day of the failure up to the head of the spike. The spikes some six weeks later were tightly gripped in the concrete, indicating that a certain degree of set had later taken place. There is no way, of course, of determining where this particular concrete was located in the building. It might have been some roof concrete which was at least seven days old at the time of the collapse. At any rate, three separate specimens (each held by a separate interest) which were examined are not what would be called good concrete. It has reached a very decided set, as would be expected in concrete two months old, but it is extremely dusty and somewhat friable on the surface. In its present condition it undoubtedly would not be considered a cause of a concrete failure, but its present condition also would throw considerable suspicion upon its strength at the time of the failure.

CONCLUSIONS

There are three factors which may contribute to the failure of a reinforced-concrete structure; the design, the materials and the construction.

The design of the Hippodrome arcade is somewhat less conservative in unit stresses than the report of the Joint Committee, but in that respect it does not differ from many other accepted reinforced-concrete designs nor can it be said these higher stresses are so dangerous as to cause failure. In the matter of beam reinforcement and connections, and column reinforcement the design follows standard practice and is at fault only so far as that practice is at fault.

Of the materials, the cement and steel are beyond criticism, but the concrete aggregate had a bad reputation in general and in this particular job was of doubtful quality, for the reports on its freedom from loam are not convincing. In fact, it seems probable that the set of the concrete was retarded by the character of the aggregate to such an extent that its strength at the time of failure was considerably less than it should have been. While there is no absolute evidence that this poor aggregate or resulting poor concrete was the cause of the collapse, suspicion may justly be directed toward it.

The construction was carried out by an experienced contractor of high reputation under the inspection of the architect. Except for the fact that the city's inspection service was perfunctory (a common enough condition) and the reinforced-concrete designer had no responsibility for the construction, the conditions of erection were ideal. The resulting work was satisfactory, except for the possible premature removal of forms and the elimination of the bracket from Columns 16 and 17, as noted above.

It seems probable—and this statement is made after listening to two absolutely contradictory statements by equally reliable men—that there was no intention to remove forms under the second floor on the day of the accident, but that there was a progressive removal and replacement of some of the struts, which might have thrown some of the girders into bearing. In view of the fact that there had been some chilly weather and particularly in view of the poor aggregate, it is more than probable that the girders thus relieved would be strained to the point of failure, although they were at the time over three weeks old. The connections at Columns 16 and 17 were decidedly weak and if the beams framing into these columns were thrown into stress by the removal of the centering, failure might readily have occurred there. It should also be noted that the centering under the first floor was removed when the columns and beams there were about four weeks old. While this is ample time under ordinary conditions, the aggregate and the temperature make this another possible failure point.

The final conclusion then is that the design of the structure was ample to have held up under the loading conditions at the time of failure if the concrete had had the expected strength of a 1:2:4 concrete three to four weeks old. This leaves as an alternative either that the basement columns and first-floor girders were not sufficiently strong at the time of collapse to carry the upper floors, or that the partial removal of struts at the street floor threw an excessive strain on the obviously weak concrete of the second floor.

An Example of Fire-Resistant Windows and Structure

The recent successful fire test passed by the new building for the Reliance Gauge Column Co., Cleveland, Ohio, is a very good testimonial to the possibilities of really fireproof construction. This company had a new building nearly ready for occupancy, when on Dec. 14 last, at 2 a.m., a fire broke out in an immediately adjoining frame building. The engines, which were soon called, were in service until 5:30 of the same morning, by which time the frame building had been totally destroyed. The fire

FIG. 1. INTERIOR OF FIRST FLOOR OF RELIANCE GAUGE COLUMN CO.'S BUILDING, CLEVELAND, OHIO, AFTER FIRE OF DEC. 14

(Note that the whole damage is the warping of the steel sash, the breaking of one or two of the wire-glass panes, and the removal of an entire steel window frame to permit the entrance of firemen to fight the fire outside. The building was about to be occupied and contained considerable loose timber.)

FIG. 2. APPEARANCE OF THE CONCRETE, BRICK AND STONE FACE OF RELIANCE BUILDING AFTER FIRE OF DEC. 14

was intensely hot as the frame building was over 30 years old, and during that time had served as a home for a number of manufacturing concerns, with the result that it was very thoroughly dried out and fairly well saturated with oil.

The new Reliance Gauge Column Co. building is a four-story structure with reinforced-concrete frame, brick curtain walls lighted with factory-ribbed wire-glass in steel sash. At a somewhat greater distance from the frame building was a brick building with wooden window frames and fire shutters of wood coated with sheet metal. In this latter building a number of the shutters were badly damaged and some of the window frames were nearly destroyed. Its contents were damaged to the extent of $5000 by fire and water.

The new reinforced-concrete building was immediately alongside of the burning structure and exposed to the full heat of the conflagration, but it resisted the fire with hardly any damage. In order to get at the blaze outside the firemen found it necessary to remove one of the steel window frames on the first floor. This was very difficult on account of the secure manner in which the frames were anchored into the structure, but by the use of a block and fall with twelve men on the line, the frame was finally torn loose and the building entered. Except for this damage and for one or two window panes broken during the fire, the damage to the concrete building was confined to the surface effect on the brick and concrete, which is well shown in the view in Fig. 2. The intense heat of the fire, it may be noted, spalled off the brick walls and the stone window sills on the second floor there shown.

The steel sash, which was of the Fenestra type, made

by the Detroit Steel Products Co., of Detroit, Mich., was warped in places, but in spite of this warping the joints around the ventilator section of the sash remain comparatively tight.

A Prominent Firm of Early American Bridge Builders

Some time ago, in an article in ENGINEERING NEWS, describing some old structural work, mention was made of "a Mr. Wilson, of Philadelphia," as having been connected with its design. This reference was to a member of the firm of Wilson Bros. & Co., whose members were among the notable bridge designers and builders in this country during the period following the Civil War.

The firm of Wilson Bros. & Co., Civil Engineers and Architects, was founded in January, 1876, by John A. Wilson, Joseph M. Wilson and Henry W. Wilson, all Members of the American Society of Civil Engineers. They were the sons of William Hasell Wilson, Honorary Member of the American Society of Civil Engineers, and also grandsons and great-grandsons of distinguished American civil engineers. John A. Wilson died Jan. 19, 1896, and Joseph M. Wilson, Nov. 24, 1902. The other brother, Henry W. Wilson, still lives in Philadelphia. After the death of the two elder brothers, the firm became Wilson, Harris & Richards, with Mr. Wilson as senior partner. Since he retired, about four years ago, the firm has been Harris & Richards.

John A. Wilson was born in 1837. He graduated from Rensselaer Polytechnic Institute in 1856 and some of his earliest engineering experience was with John C. Trautwine, as topographer on railway surveys in Central America. From 1858 until the formation of the firm of Wilson Bros. & Co., he was with the Pennsylvania R.R. and its subsidiaries, except during the Civil War period, when he served as Captain on the staff of General Couch. Mr. Wilson was at various times Chief Engineer of the Philadelphia & Erie R.R. (Pennsylvania R.R. Co., lessee), Chief Engineer of Maintenance-of-Way on the main line of the Pennsylvania R.R. and Chief Engineer of Location and Construction of the Low-Grade Division of the Allegheny Valley R.R. He was a member of the American Institute of Mining Engineers and of the Franklin Institute.

Joseph M. Wilson was born in 1838 and graduated from Rensselaer Polytechnic Institute in 1858. He entered the service of the Pennsylvania R.R. in 1860, and in the course of a few years became Engineer of Bridges and Buildings, which office he retained until 1886. He served as Engineer and Expert for several Commissions on public works, including the Washington, D. C., tunnel and reservoir, the Providence, R. I., terminal problem, approaches of the Brooklyn Bridge, New York City, and New York City rapid-transit problems. He was the author of many papers and articles on engineering subjects. He was a member of the Institution of Civil Engineers of Great Britain and a winner of the Telford Premium of that Society, a Fellow of the American Institute of Architects, a past-president of the Franklin Institute and of the Engineers' Club of Philadelphia.

Henry W. Wilson, the surviving brother, was born in 1843. He graduated at the Rensselaer Polytechnic Institute in 1864. He was engaged on surveys for the Southern Pennsylvania R.R. in southern and western Pennsylvania as Assistant Engineer. In 1866 he resigned to enter the service of the Pennsylvania R.R. Co. where he was employed in bridge designing and in construction work until he entered the firm of Wilson Bros. & Co.

Notes from Engineering Schools

YALE UNIVERSITY—Land for a summer surveying camp has been obtained by the Sheffield Scientific School. It is located in East Lyme, Conn., about 40 miles from New Haven and easily accessible by the Shore Line Electric Ry. A number of farms have been purchased, which, with a strip of land donated by Morton F. Plant, make a tract 3½ miles in length and 1½ wide in portions, altogether embracing more than 1400 acres. The topography is varied and is adaptable to all kinds of surveying work. For over a mile a portion of the land borders on an inland lake. Rising up from the lake is elevated ground, making an admirable location for the camp site

CORNELL UNIVERSITY—This fall, for the first time, the entering class in the five-year course in mechanical engineering registered in Sibley College and will consequently be under the supervision of this college from the time it matriculated until it graduates. Formerly the students in this course registered in the College of Arts and Sciences during the first two years. The young man who has completed the ordinary four-year high-school course, but who is not credited with the full four units of mathematics required for admission as a four-year engineering student, may now enter Sibley College in the five-year course; thus, instead of spending an additional year in a preparatory school in order to secure the mathematical training required for the four-year course, he may enter at once and obtain an additional year's work in college and thereby secure a more liberal training than is afforded by the regular course, which is limited to engineering subjects or those preparatory to such. This extra work may be distributed through the five years in such manner that, starting with elementary courses in the first year, the student may subsequently pursue in proper sequence the more advanced courses based on the preliminary ones. The extra time may be devoted to liberal or cultural subjects, to courses preparatory for the business or administrative side of engineering, to specialization in chemistry, physics or geology, or to mining or civil engineering.

KANSAS STATE AGRICULTURAL COLLEGE—The Division of Mechanic Arts has established a group of short courses in mechanic arts more or less parallel to the short courses usually given in agriculture. Courses are offered in (1) concrete construction; (2) shop work, including wood and iron working; (3) road building, irrigation and drainage; (4) steam and gas traction engines. These are open to men not less than 18 years of age, who have had a fair common-school education. Each course is ten weeks in duration, and will be offered during the winter term, beginning Jan. 5, 1915.

The college has also recently established, in its secondary school, a series of trade practice courses in mechanic

arts. Courses are given in (1) blacksmithing, (2) carpentry, (3) concrete construction, (4) gas engines, (5) steam engines and boilers, and (6) traction engines. Persons who are 14 years of age or older, and who have completed the eighth grade of the public schools, are admitted to these courses without examination. The courses are each three years in length, and have much work in common, including English, mathematics, history, physics, drawing and beginning shopwork. The differentiation comes mostly in the second and third years, in the former of which about one-third and in the latter of which three-fifths of the time is devoted to the specialized subjects. The purpose of the courses is to teach the elements of the trades, while a general training is being given similar to that of the high school, with the foreign languages omitted.

The Department of Civil and Highway Engineering is planning to give a short course in road building, irrigation and drainage during the coming winter. The course will be of ten weeks' duration and is intended to accommodate county surveyors and county engineers, at present in practice, who desire additional technical work along lines in which they are particularly interested. Surveying, road construction, bridge and culvert construction, road laws and administration, irrigation and drainage engineering, and specifications and contracts are among the subjects which will be treated in the course.

NEWS NOTES

A 30-In. Water Main Burst in Portsmouth, Ohio, on Dec. 16. The main was located 6 ft. below the surface. The work of repairing the main began early on Dec. 17 and was completed on Dec. 20.

By Recent Annexation Richmond, Va., has added materially to its area and increased its population by some 20,000.

Typhoid Fever in Chicago has shown some increase lately, and the Health Department attributes this to pollution of the water-supply taken at the Chicago Ave. pumping station. Consumers have been advised to boil the water, and treatment with hypochlorite of lime has been instituted.

The Near-Side Stop Is a Success in New York, according to reports received by the Safety First Society, from the officials of the companies operating surface car lines. For example, the Third Ave. Ry. Co. reported a decrease of 245 accidents during September, October and November of this year over the same period in 1913. The near-side stop ordinance became effective Sept. 1.

The Water-Supply of Steamers on the Great Lakes is a serious menace to public health according to the annual report of Dr. Blue, Surgeon-General of the U. S. Public Health Service. It is pointed out that about 16,000,000 passengers are carried annually by steamers which draw their water-supply from the lake, and he recommends that this water should be treated on board the vessels before being distributed for drinking purposes.

An Automobile Speedway to be built for the Chicago Speedway Association will have a 2½-mile oval track designed for the highest possible speeds. The track will be 70 and 80 ft. wide on tangents and curves respectively, and will have a wood surface on a concrete base. Subways under the track will give access to the infield, which will be used for parking vehicles. Graham, Burnham & Co., of Chicago, are the architects.

The Smallest Central Electric Station in the country is probably that at Waldo, Wis., instead of the one in Clayton, Wis., noted in "Engineering News," Nov. 5, 1914. Five customers are supplied with 30-volt direct-current survice from a ¾-kw. generator and storage battery. The town has 325 population and is undergoing a transition from kerosene to electric lights. There is a transmission line within 4½ miles of the village and service from it is agitated.

The Gold Medal for Safety presented annually by the Travelers Insurance Co. under the direction of the American Museum of Safety to "the American employer, either an individual or a corporation, who during the year has, in the judgment of the jury of awards of the Museum, achieved the most for the safety of employees," has been awarded this year to the Commonwealth Edison Co., of Chicago. The four previous winners of the gold medal have been the United States Steel Corporation, the Pennsylvania R.R. Co., the New York Edison Co. and the New York Telephone Co.

Municipal Improvements at Quito, Ecuador, are not as yet very extensive, according to a report received from a South American correspondent. The city has about one-half mile of streets paved with Belgian blocks, 28 miles with rough cobbles and 12 miles unpaved. The city has recently entered into a contract with William Schroeter & Co., a German concern, for installing fire hydrants and for putting in sewers. The city expects to buy fire engines soon. Our correspondent states that: "Heretofore, fires have been very rare and have been extinguished by hand or allowed to burn out. The houses are separated by very thick walls (3 ft.), and there is very little in them to burn."

Motorman's Cab Signals are provided for in the new automatic signal system adopted by the New York Municipal Railway for its portion of the new subway lines to be operated in New York City. The award of the contract for this system to the General Railway Signal Co. has been approved by the Public Service Commission. The new system provides block intervals and speed control with signals in the motorman's cab; if for any reason he fails to slow down at proper signals, a track device engages car attachments automatically reducing the speed to the desired rate independent of the motorman's action. Thus the train is allowed to continue at properly reduced speed, but is not stopped completely, as at present is necessary with the use of track trips in connection with block signals. The total bid of the Signal Company for equipping all the subway and elevated lines to be operated by the Municipal Railway Corporation is about $1,413,000. The Public Service Commission is considering the issue of an order requiring the installation of such signals on the elevated lines in New York City, on which two serious accidents have occurred recently—both due to failure of the employees to perform their duties properly.

New York's Engineer Regiment Disbanded—An order by Governor Glynn of New York disbanding the 22d Regiment of Engineers, New York National Guard, was issued on Dec. 24. It reads as follows:

> In accordance with the military law and to meet the requirements of the War Department, the Corps of Engineers is reorganized as follows: The regimental organization of the Corps of Engineers, known as the 22d Regiment, N. G. S. N. Y., and the battalions and companies as now constituted, except the band, are hereby disbanded. The officers serving with the same being surplus are hereby placed on the reserve list. The enlisted men will be transferred or discharged, as may be necessary to carry out this order, and will be continued in the service until so transferred or discharged.
>
> Only 15 of the officers will be retained, it is reported, and 25% of the enlisted men will be discharged or transferred to other regiments. Major-General O'Ryan, commanding the state militia division, said: "The 22d Regiment is steeped in old infantry methods. All the officers and men capable of performing the services expected of engineers will be assigned to duty after the regiment is disbanded and the battalions reorganized." A special examining board (Colonel Van C. Lucas, chief engineer officer of the state militia, President) has been appointed to pass upon the qualifications of the officers.

PERSONALS

Mr. Milton H. Bronsdon has been reappointed Chief Engineer of Power and Lines of the Rhode Island Co., Providence, R. I. He was Chief Engineer from 1907 to 1912, and since then has been engaged in general practice in San Francisco, Calif.

Mr. Friend P. Williams, M. Am. Soc. C. E., Resident Engineer of the New York State Barge Canal, Mechanicsville, N. Y., has been apointed Division Engineer of the Western Division under State Engineer-elect Frank M. Williams, M. Am. Soc. C. E.

Prof. Charles M. Spofford, M. Am. Soc. C. E., head of the technology department of civil and sanitary engineering, Massachusetts Institute of Technology, has been appointed Expert Advisor for the City of Cambridge, Mass., in connection with some taxation problems.

Mr. J. A. Almirall, M. Am. Soc. M. E., and W. C. Adams announce that, owing to the recent death of Quimby N. Evans,

the copartnership known as Evans, Almirall & Co. has been dissolved and corporation of Almirall & Co., Inc., has succeeded to the business of the former firm. The new company has the same personnel as the old firm, with the exception of Mr. Evans.

Mr. Guy Moulton, M. Am. Soc. C. E., First Resident Engineer, Middle Division, New York State Barge Canal, has been appointed Division Engineer of the Middle Division by State Engineer-elect Frank M. Williams, M. Am. Soc. C. E. Mr. Moulton has been connected with the Barge Canal work for a number of years and was Division Engineer during the former administration of Mr. Williams.

Mr. George D. Williams, M. Am. Soc. C. E., of Durhamville, N. Y., a brother of Mr. Frank M. Williams, M. Am. Soc. C. E., State Engineer-elect of New York, has been appointed Division Engineer of the Eastern Division of the New York State Canals, to succeed Mr. D. B. La Du, Assoc. M. Am. Soc. C. E. Mr. Williams was Division Engineer under the former administration of his brother as State Engineer.

Mr. Henry E. Breed, M. Am. Soc. C. E., of Cornwall, N. Y., has been appointed Terminal Engineer of the New York State Barge Canal, at a salary of $6000 per annum, to succeed Mr. J. A. O'Connor, Assoc. M. Am. Soc. C. E. Mr. Breed graduated from Colgate University in 1900 and began his engineering experience as a draftsman with the Newport News Shipbuilding & Drydock Co., Newport News, Va. From 1901 to 1911 he was with the New York State Highway Department. In 1912 he made an extended tour in Europe to study road and waterway engineering, and since then he has been in private practice.

Major J. F. de Pulligny, official representative of the French Government in the United States in connection with the post-graduate work of students from French engineering schools in American engineering work, returned to France last spring for a short vacation, and his services were immediately required there when war was declared. During the early months of the war he was assigned to duty in connection with the Quartermaster's Department. In a letter dated Nov. 19, to Mr. C. O. Mailloux, of New York City, Major de Pulligny stated that he had been just assigned to duty as Major of a battalion of territorial engineers, and expected shortly to leave for the front.

Mr. W. W. Marr, M. Am. Soc. C. E., whose appointment as State Highway Engineer of Illinois was briefly noted in our issue of last week, was born in Chicago in 1876. He graduated from Notre Dame University of Indiana in 1895, and received a C. E. degree there in 1896. For 15 years he was in the employ of the City of Chicago, Ill., as Assistant Engineer and as Division Engineer. Six years of his experience were spent in harbor work, water-supply tunnels, pumping stations, etc., and nine years as Division Engineer in charge of special assessment improvements such as pavements, sewers, etc. For the past six years Mr. Marr has been in private practice as a member of the firm, the Aetna Engineering Bureau, Civil and Sanitary Engineers, Chicago.

OBITUARY

F. X. Dion, President of the Lauzon Engineering Co., Ltd., Engineers and Contractors, of Levis, Que., died on Dec. 17, at his residence at Lauzon, Que.

James Culbertson Clow, Vice-President of James B. Clow & Sons, of Chicago, manufacturers of cast-iron pipe and plumbing supplies, died at Lake Forest, Ill., Dec. 25. He was 41 years of age. He leaves a widow and one son.

John Norton, one of the oldest contractors of Kansas City, Mo., died Dec. 8. He was born in Ireland and came to Kansas City 36 years ago. His two sons now carry on the business founded by their father, under the name of Norton Bros.

Richard D. Evans, a former civil engineer and at one time a member of the commission of consulting engineers on New Orleans drainage and flood protection, died at his home in New Orleans, La., Dec. 21, aged 74 years. He was born in Washington, D. C., and some of his early experience was with the United States Coast and Geodetic Survey. For many years he was engaged in railway construction in the South and the Southwest.

W. R. Eckart, M. Am. Soc. C. E., Consulting Engineer, of San Francisco, Calif., died Dec. 8, at his home in that city. He was born in Chillicothe, Ohio, in 1841. He was educated at the St. Clair St. Academy, Cleveland, Ohio, and in 1861 passed an examination for Engineer, U. S. N. He was assigned to the Pacific coast fleet. In 1864 he resigned from the Navy and entered private practice as a designer of locomotives and mining machinery. In 1872 he was engaged as Consulting Engineer on the famous Sutro Tunnel in Nevada. Later he was employed by the U. S. Geological Survey to report on the mechanical apliances of the Comstock Lode, at Virginia City, Nev. For the past 30 years he was a Consulting Engineer with offices in San Francisco.

ENGINEERING SOCIETIES

COMING MEETINGS

SOCIETY OF CONSTRUCTORS OF FEDERAL BUILDINGS.
Jan. 4-6. Convention at Washington, D. C. Secy., T. R. Maul, 4213 Westminster Ave., Philadelphia, Penn.

ASSOCIATION OF GOVERNMENT CONTRACTORS.
Jan. 4-7. Annual meeting at Washington, D. C. Secy., Algernon Blair, Montgomery, Ala.

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS.
Jan. 15. Annual meeting at New York City. Secy., J. R. Wemlinger, 11 Broadway, New York City.

AMERICAN WOOD PRESERVERS' ASSOCIATION.
Jan. 19-21. Convention at Chicago, Ill. Secy., F. J. Angier, Mt. Royal Station, B. & O. R.R., Baltimore, Md.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 20-21. Annual meeting in New York. Secy., Charles Warren Hunt, 220 W. 57th St., New York City.

AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS.
Jan. 20-22. Annual meeting at New York City. Secy., J. J. Blackmore, 29 W. 39th St., New York City.

INDIANA ENGINEERING SOCIETY.
Jan. 21-23. Annual meeting at Indianapolis. Secy., Charles Brossmann, 1616 Merchants Bank Building, Indianapolis, Ind.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.
January 27-29. Annual meeting at Springfield, Ill. Secy., E. E. R. Tratman, 1144 Monadnock Block, Chicago.

AMERICAN CONCRETE INSTITUTE.
Feb. 9-12. Convention at Chicago, Ill. Secy., E. E. Krauss, Harrison Bldg., Philadelphia, Penn.

AMERICAN CONCRETE PIPE ASSOCIATION.
Feb. 15-16. Annual convention at Chicago. Secy., E. S. Hanson, 538 South Clark St., Chicago, Ill.

IOWA ENGINEERING SOCIETY
Feb. 17-19. Annual meeting; at Iowa City. Secy., S. M. Woodward, Iowa City, Iowa.

Cornell Society of Civil Engineers—The annual banquet and reunion in New York City will be held on Jan. 22.

American Public Health Association—It has been decided to hold the next meeting of the Association in Rochester, N. Y., probably in September, 1915.

Missouri Highway Engineers' Association—At the annual meeting of the Association, held in Jefferson City, Mo., on Dec. 17, the following officers were elected: President, F. C. Harding; Secretary, E. W. Sheets, Hannibal, Mo. The meeting next year will be held at Hannibal.

National Lime Manufacturers' Association—The annual meeting will be held in Washington, D. C., Feb. 3-4, at the New Willard Hotel. One of the objects it is desired to attain is to convert the Treasury Department to the use of lime in the concrete of public buildings. The Secretary is Fred K. Irvine, Chicago, Ill.

American Institute of Consulting Engineers—The annual meeting of the Institute will be held on Jan. 19, at the City Club, New York City, at 8 p.m. Three members of the Council will be elected. Ballots will be canvassed for the adoption of the amended constitution and bylaws as prepared by the special committee appointed at the last annual meeting. The Secretary is Eugene W. Stern, 101 Park Ave., New York.

Engineers' Club of Trenton—At the annual meeting of the Engineers' Club of Trenton, N. J., Alfred C. Gregory, city engineer of sewers, was elected President. By virtue of constitutional provision, Newton A. K. Bugbee, Second Vice-President, became First Vice-President; and Fred C. Carstarphen, tramway engineer of the American Steel & Wire Co., was elected Second Vice-President. Joseph E. English, assistant engineer of the Department of Streets, was reëlected Secretary and John E. Eilliott, engineer in charge of the drawing room of the American Bridge Co., was elected Treasurer.

Youngstown Engineers' Club—The semi-annual banquet was held on Dec. 17, at the Hotel Ohio, and attended by about 75 members and guests. The address of the evening—"The Engineer in the Community"—was delivered by F. E. Schmitt, Associate Editor, "Engineering News." The speaker argued for the necessity of local engineering organization, not merely for discussing local engineering problems and works, but primarily for the purpose of creating professional fellowship among engineers, whose present-day lack can be blamed for various undesirable conditions. Emphasis was also laid on the power of an engineering organization to coöperate in public problems and community affairs generally.